APPLEBY'S HANDBOOK OF MACHINERY.

SECTION II.

HOISTING MACHINERY.

APPLEBY'S
ILLUSTRATED HANDBOOK
OF
MACHINERY.

SECTION II.—HOISTING MACHINERY,

INCLUDING

WINDING ENGINES, HYDRAULIC, STEAM, ELECTRICAL AND HAND CRANES,

WINCHES, JACKS AND OTHER LIFTING APPLIANCES.

WITH

PRICES, WEIGHTS, MEASUREMENTS, AND SOME DATA ON WORKING EXPENSES AND RESULTS OBTAINED.

BY

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[JESSOP & APPLEBY BROS., (LEICESTER & LONDON,) LIMITED.]

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APPLEBY'S HANDBOOK OF MACHINERY.

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The Edition published in 1869, and several reprints of it having been exhausted, a New Edition (of which this section forms a portion) is now being completed; and for the convenience of those who desire information on specific subjects, but not on all those treated, the book is divided into seven sections, each of which may be obtained separately as follows:—

SECTION 1.—**PRIME MOVERS.**

STEAM, GAS AND AIR ENGINES, BOILERS, DYNAMOS, MOTORS, TURBINES, ETC.

SECTION 2.—**HOISTING MACHINERY.**

WINDING ENGINES, HYDRAULIC, STEAM, ELECTRICAL AND HAND CRANES. WINCHES, JACKS AND OTHER LIFTING APPLIANCES.

SECTION 3.—**PUMPING MACHINERY.**

PUMPING ENGINES, CENTRIFUGAL, STEAM, ELECTRICAL AND HAND PUMPS.

SECTION 4.—**MACHINE TOOLS**
AND ACCESSORIES.
FOR WORKING METALS, WOOD, ETC.

SECTION 5.—**CONTRACTORS' PLANT AND RAILWAY MATERIALS**

INCLUDING MACHINERY AND MATERIALS FOR THE CONSTRUCTION AND EQUIPMENT OF RAILWAYS AND OTHER PUBLIC WORKS.

SECTION 6.—**MINING, COLONIAL AND MANUFACTURING MACHINERY.**

FOR TREATING ORES, CORN, COFFEE, RICE, SUGAR, COTTON, AND OTHER PRODUCTS, OIL MILLS, ICE MAKING, DISTILLING, ETC.

SECTION 7.—**USEFUL TABLES AND MEMORANDA.**

FOR ENGINEERS, MERCHANTS, AND MANUFACTURERS.

Each Section, bound in cloth, is sold separately, price 3/6 each.

The subject matter has been entirely re-written, and is illustrated by a large number of Engravings which (for the most part) represent work carried out by the Author's Firm.

The arrangement is intended to be in a handy form for reference, useful alike to engineers, users, and to purchasers of machinery and of materials connected therewith.

The prices are based on the present cost of materials and of labour and these—as well as details of design and proportions—are necessarily subject to modification without notice.

Some data is given with reference to the cost of working, motive power required and work performed; also approximate weights and measurements, so that the results obtainable and the total cost including freight, import duties, &c., may be roughly estimated. The cost of packing for shipment and delivery to docks varies with the nature of the packing required and the destination, the rates given being the average as nearly as they can be determined.

Code Words for each kind of machine will be found in the index, and these, in conjunction with the sentence words in Appleby's Copyright Telegraph Code which precedes the Index, will usually suffice for correspondence by cable; by specifying the price, Fig. No., or page in figures, the leading dimensions of the tool required can be indicated. An example of the mode of using this and other codes will be found at page IV.

APPLEBY'S COPYRIGHT TELEGRAPHIC CODE

FOR CORRESPONDENCE BY TELEGRAM.

NOTE.—CABLE ADDRESS: "MILLWRIGHT, LONDON."

The code numbers are for use in case a repetition of the telegram may be necessary.

ENQUIRIES AND QUESTIONS.

191290	**Taaier**	..Telegraph how soon you could ship the following, viz.....
191291	**Taaiheid**	..Reply, by letter, how soon you could ship the following, viz.....
191292	**Taainagel**	Telegraph at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz.....
191293	**Taalboek**	Reply, by letter, at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz.....
191294	**Taaldeel**	Telegraph how soon and at what price, packed and delivered f.o.b., you could supply and ship the following, viz.....
191295	**Taaleigen**	Reply, by letter, how soon and at what price, packed and delivered f.o.b. English port, you could supply and ship the following, viz. .....
191296	**Taalfout**	..Telegraph name of vessel by which you have shipped.
191297	**Taalgebrek**	We learn that the.....with your goods on board has been lost. Shall we replace?
191298	**Taalgids**	..Telegraph, at my expense, how soon my order will be despatched.
191299	**Taalgrond**	..Reply, by letter, how soon my order will be despatched.
191300	**Taalkundig**	..Do you wish us to proceed with order?
191301	**Taalman**	..Will you leave matter to our discretion?
191302	**Taalregel**	..When will remittance be sent for £.....
191303	**Taalschat**	..Send us a complete tracing of.....
191304	**Taalteeken**	..Send us a photograph of.....
191305	**Taalvitter**	..Send us a complete estimate for the following.....
191306	**Taalvriend**	Prepare design and send tracing and estimate including delivery f.o.b. for.....
191307	**Taalwet**	..Can you alter the goods to our order as follows.....
191308	**Taalzifter**	..How soon can you deliver?
191309	**Taanbloem**	..Have you in stock?
191310	**Taartblik**	..A reply by wire is requested.
191311	**Taarten**	..A reply by first mail is requested.

ORDERS AND INSTRUCTIONS.

By Sailing Vessel.	Steamer.	Mail Boat.	
191312 **Taartepan**	191313 **Taartjes**	191314 **Taartkoek**	Please supply and ship as soon as possible the following goods, engaging freight and insurance, free of particular average.
191315 **Tababocca**	191316 **Tabacalero**	191317 **Tabacales**	Please supply and ship as soon as possible the following goods, engaging freight and insurance, free of all risks, if latter is possible.

191318	**Tabaccasse**	..No part of the machine must weigh more than.....cwts.
191319	**Tabacchi**	..We leave matter to your discretion.
191320	**Tabacomane**	..Preferring them in the order named.
191321	**Tabacosas**	..Payments will be made by.....
191322	**Tabacoso**	..Payments will be made by..... Arrange terms with that firm.
191323	**Tabagie**	..Terms will be as before.
191324	**Tabagique**	..Remittance is delayed until.....
191325	**Tabahia**	..Draw on us at sight for £.....
191326	**Tabakasche**	..Draw on us at.....
191327	**Tabakbau**	..Await instructions for shipment.
191328	**Tabakbeize**	..Replace with all possible despatch.
191329	**Tabakdampf**	..Duplicate our order of.....
191330	**Tabakkorb**	..Repeat our order for.....
191331	**Tabakladen**	..Repeat our last order.
191332	**Tabakqualm**	..Await our letters before proceeding.

Orders and Instructions—*Continued.*

191333	**Tabakrauch**	Same pattern or quality as before.
191334	**Tabakreibe**	The same as you last supplied.
191335	**Tabakrolle**	Same as supplied by you in.....
191336	**Tabaksblad**	Same as supplied by.....in.....
191337	**Tabaksbouw**	Same as supplied to.....in.....
191338	**Tabaksland**	Draw on us for £.....at the following number of days from sigh
191339	**Tabakspijp**	Please deliver at once.
191340	**Tabaksrook**	Please deliver next week.
191341	**Tabakstube**	Must be inspected by.....
191342	**Tabaksvat**	Ship at once.
191343	**Tabaksveld**	.....has been irreparably damaged send another.
191344	**Tabakszak**	.....has been lost replace it immediately.
191345	**Tabaleabau**	Please send by next mail certificate for.....
191346	**Tabaleara**	Prepare for delivery at once.
191347	**Tabaleos**	Wanted for immediate delivery.
191348	**Tabalhiom**	The makers were (are).....
191349	**Taballiado**	As described in Appleby's Handbook of Machinery, price £.....
193491	**Tabanidae**	As illustrated in ,, ,, ,, Fig.....
193492	**Tabanus**	As described in ,, ,, ,, page.....

ANSWERS, &c.

191350	**Tabanca**	Freight will add about.....per cent. to the f.o.b. cost.
191351	**Tabanquet**	The machine will weigh about.....cwts.
191352	**Tabaquear**	The total weight will be about.....tons.
191353	**Tabaqueiro**	The total measurement will be about.....cubic feet.
191354	**Tabaqueras**	No part of the machine will weigh more than .....cwts.
191355	**Tabaqueurs**	The machine is finished.
191356	**Tabaquista**	We can supply you with goods, as per your enquiry, at the following *net* price.
191357	**Tabardelha**	Please telegraph credit with some English Bank for order just received.
191358	**Tabarder**	The credit opened with the Bank is too small; please to telegrap further credit for £.....
191359	**Tabardilho**	We cannot execute order on other terms.
191360	**Tabarzet**	We have remitted you by letter £.....
191361	**Tabatiere**	Cash will be paid against Bill of Lading by.....
191362	**Tabaxir**	Machinery is shipped by steamer.
191363	**Tabbard**	Machinery will be shipped by steamer.
191364	**Tabbaoth**	Machinery is shipped by sailing vessel.
191365	**Tabbinet**	Machinery will be shipped by sailing vessel.
191366	**Tabbying**	Your order received and has our best attention.
191367	**Tabebuia**	Remittance follows by mail.
191368	**Tabefatto**	Remittance will be sent immediately for £.....
191369	**Tabefied**	Waiting your remittance.
191370	**Tabellaria**	Credit arranged through.
191371	**Tabellaron**	Credit arranged by telegraph.
191372	**Tabelle**	£10 additional needed to cover cost.
191373	**Tabelliar**	£20 ,, ,, ,,
191374	**Tabellioa**	£30 ,, ,, ,,
191375	**Tabellions**	£40 ,, ,, ,,
191376	**Tabellone**	£50 ,, ,, ,,
191377	**Taberd**	£60 ,, ,, ,,
191378	**Tabergite**	£80 ,, ,, ,,
191379	**Tabernacle**	£100 ,, ,, ,,
191380	**Tabernero**	£ ,, ,, ,,
191381	**Tabescence**	We can deliver from stock.
191382	**Tabescent**	,, ,, in one week.
191383	**Tabetique**	,, ,, in two weeks.
191384	**Tabicadas**	,, ,, in three weeks.
191385	**Tabicamos**	,, ,, in four weeks.
191386	**Tabicar**	,, ,, in six weeks.
191387	**Tabicaron**	The time for delivery should be.....weeks.
191388	**Tabicones**	The time of delivery is of great importance.
191389	**Tabido**	All charges will be accounted for.....
191390	**Tabificas**	All charges will be paid by.....
191391	**Tabiflui**	I (we) cannot promise delivery until.....
191392	**Tabifluos**	I (we) cannot promise delivery in the time stated, letter follows

Answers, &c.—*Continued.*

191393	**Tabiosis** ..	I (we) cannot promise delivery in time stipulated, please telegraph instructions.
191394	**Tabique** ..	..We have not received yours of the.....
191395	**Tabiqueis** ..	Replying to your telegram, (enquiry) our price is £.....
191396	**Tabiquemos**	Replying to your telegram, our price, subject to prompt confirmation of order, will be £.....
191397	**Tabiser** ..	..Full information follows by mail.
191398	**Tablacho** ..	..Tracing and estimate will be sent.
191399	**Tablabo** ..	..Tracing and estimate were sent.
191400	**Tablajero** ..	..We have received your order for.....

GENERAL MESSAGES.

191401	**Tablares** ..	.....steamer is delayed by having to put in at.....
191402	**Tablazones** ..	.....is erected and works satisfactorily.
191403	**Tablazos** ..	.....is erected but does not work satisfactorily.
191404	**Tableabais** ..	.....is erected but does not yet work satisfactorily, send immediately by quickest route.
191405	**Tableadas** ..	.....will leave on or about the.....
191406	**Tablearia** ..	.....cannot leave before the.....
191407	**Tablearon** ..	.....is completed.
191408	**Tableaux** ..	..I (we) will see you on or about.....
191409	**Tableros** ..	..We must have dimensions, sketches, or drawings.
191410	**Tabliers** ..	..We require more detailed information with reference to.....
191411	**Tablilha** ..	..We are sending you additional information with reference to.....
191412	**Tablon** ..	..We last heard from you on the.....
191413	**Tabloza** ..	..Refer to our letter dated.....
191414	**Taboas** ..	..Refer to our telegram dated.....
191415	**Taboinha** ..	..We refer to your letter dated.....
191416	**Tabolagem** ..	..We refer to your telegram dated.....
191417	**Taboleiro** ..	..Have you received our order for.....
191418	**Taboleta** ..	..We have not received your order for.....
191419	**Tabooed** ..	..Please send necessary instructions.
191420	**Taboriten** ..	..Please send confirmation by letter.
191421	**Tabouer** ..	..We forward by steamer advertised to close on the.....
191422	**Tabouret** ..	..Can you forward by the.....
191423	**Tabourine** ..	..The Bill of Lading must be to the order of.....
191424	**Tabraca** ..	..The Bill of Lading must be sent to.....
191425	**Tabrimon** ..	..The Bill of Lading has already been sent to.....
191426	**Tabual** ..	..The Bill of Lading has not been received.
191427	**Tabuda** ..	..Delivery cannot be made until we have the Bill of Lading.
191428	**Tabularize** ..	..Have you received the Bill of Lading.
191429	**Tabulating** ..	..Insure to cover cost, freight and insurance.
191430	**Tabulista** ..	..Insure to cover all charges and risks if latter is possible.
191431	**Taburno** ..	..We accept your order for.....
191432	**Tacahout** ..	..We accept your order dated.....
191433	**Tacamaca** ..	We cannot accept your order on terms proposed, please refer to our offer.
191434	**Tacca** ..	..Forward as early as possible.
191435	**Tachylite** ..	..We accept your offer dated.....
191436	**Tachypetes** ..	..We can carry out your proposals at extra cost of £.....
191437	**Tacitly** ..	.. ,, ,, ,, without extra cost.
191438	**Taciturn** ..	..Details of conditions are sent by mail.

DIMENSIONS, &c.

191439	**Tackduty** ..	..The gauge (or span) is.....inches.
191440	**Tackled** ..	..The radius is.....feet.
191441	**Tackling** ..	..The height of lift is.....feet per minute.
191442	**Tacksman** ..	..The speed of lift is.....feet per minute.
191443	**Tackspins** ..	..The maximum load is.....cwts.
191444	**Tactical** ..	..The average load is.....cwts.
191445	**Tadorna** ..	..The machine must take in.....inches.
191446	**Tadpoles** ..	..The output per hour is.....
191447	**Taffata** ..	..The effective horse power is.....

EXAMPLES OF CODE TELEGRAMS.

The following exchange of Telegrams shows the mode in which the Code may be used :—

A correspondent telegraphs "**Taaldeel Baciasse 900 Tabanidae 2189**" which, on reference to the Code will be found to translate as follows: "Telegraph how soon and at what price, packed and delivered f.o.b., you could supply and ship the following, viz.: Locomotive Steam Crane, 10 tons power, as illustrated in Appleby's Handbook of Machinery, Fig. 2189."

The reply to this was "**Tabiquemos 880 Tabicar**" which reads as follows: Replying to your telegram, our price, subject to prompt confirmation of order, will be £880; we can deliver in six weeks."

On receipt of this our correspondent telegraphed: "**Taartjes Baciasse Tabacoso**" which reads: "Please supply and ship per steamer as soon as possible the following goods, engaging freight and insurance free of particular average. Locomotive Steam Crane; payments will be made by..... Arrange terms with that firm."

THE A1 TELEGRAPHIC CODE.

The Code words pages i. to xi. conflict, to some extent, with those in the widely used A1 Code, but no confusion can arise if the latter is used *exclusively*, the subjoined (or other agreed) words being employed to clearly identify the Section of the Handbook referred to, thus :—

APPLEBY'S	HANDBOOK	OF	MACHINERY,	SECTION I.	**Admugitum**
,,	,,	,,	,,	II.	**Adnatobat**
,,	,,	,,	,,	III.	**Adociria**
,,	,,	,,	,,	IV.	**Adoliridas**
,,	,,	,,	,,	V.	**Adumbrato**
,,	,,	,,	,,	VI., PART A.	**Adonteremo**
,,	,,	,,	,,	VI., PART B.	**Adopertus**
,,	,,	,,	,,	VII.	**Adoptames**

and the words in the Code which indicate, respectively, the number of page and line referred to, the dimensions of the machine, &c.

Example.—A correspondent who desires to have a locomotive steam crane as illustrated and described at pages 50 and 51 of this Section—using the A1 Code as above described and the Code word for the Section—cables: "**Feriato Emollicas Gerade Trasmitir Trasminata Adnatobat.**"

On reference to the A1 Code, this message will be found to read: "Forward as soon as possible a steam locomotive crane to lift 10 tons, with steam derrick motion, radius of jib 16 ft., engines 8½ × 12 inches, page 51, line 45, Appleby's Handbook of Machinery, Section II."

CONTENTS

AND CODE WORDS FOR USE IN CONJUNCTION WITH APPLEBY'S COPYRIGIIT TELEGRAPHIC CODE.

SECTION II.

HOISTING MACHINERY.

CRANES AND HOISTING MACHINERY.

The following descriptions and illustrations may be regarded as fairly representative of machinery of this kind in general use, although lack of space precludes reference to many useful appliances for lifting and transferring loads, grain storage, etc. These, however, come under the category of "Special Machines" which must be designed to fulfil the conditions indicated in each case by sketches with figured dimensions and other necessary information.

Considerable divergence of opinion exists with regard to some of the matters referred to in the following remarks, but a brief record of the observations made during the best parts of a life devoted by the Writer to the design, construction, and working of cranes and lifting machinery, may perhaps be useful to those whose attention has been directed to this subject less closely and continuously than his has been.

Margins of safety.—It is by no means uncommon to see a factor of safety of 5 (or even less) in parts which must sustain great and constantly recurring strain, whilst other parts of the structure which are subject to strains much less severe, have larger and unnecessarily high factors of safety. The result of this improper distribution of material—due to defective design—is, that the actual strength of the machine is much below that which the total weight should indicate.

This subject is again referred to in the remarks on "Test Loads" but it may be well to mention that the average factor should rarely be less than 5 or 6 and still more rarely reach 10, for any part.

Weights of machines.—As indicated in the preceding paragraph, the weight of a well designed machine of a given capacity ought—and usually does—convey some idea of its fitness for the work to be performed, due allowance being made for the higher qualities of materials now frequently used in the construction of some types of cranes whereby the margins of safety are increased and—to some extent—the cost.

Rigidity of construction.—It is not always recognised that lifting machinery should be designed with special reference to the degree of rigidity desirable in the different members and that the greatest possible rigidity should be provided in certain portions of the structure whilst—in others—some elasticity is a distinct advantage.

Facilities for examination.—Another detail to which attention is not always sufficiently directed is the arrangement of parts to afford facilities for supervision and maintenance.

Speeds of working.—It is often assumed that cranes with exceptionally high speeds will get through more work than those with normal speeds. This is a fallacy, because the quantity of work a crane will do is really regulated and limited by the time required to prepare and sling the load, and to release and stow it. In practice it is rarely possible, even when loading or discharging minerals or light cargo, to make more than 30 to 40 operations per hour, and if the normal speeds of cranes for this purpose are 80 to 100 feet per minute for lifting, and 100 to 120 feet for slewing, the crane easily makes 60 operations per hour which leaves a margin quite ample for all practical purposes.

These remarks apply more especially to cranes of 2 to 3 tons power for "whipping" comparatively light loads. The speeds of cranes of larger power, for miscellaneous work, are reduced by double or treble purchase gear to bring them into near relation with the time required to sling and discharge the loads. But the speeds of working steam cranes are completely controlled by the link motion reversing gear and—to a large extent—are automatically regulated by the speed of the engines being reduced in proportion with the weight lifted.

Maximum loads.—Unless otherwise specified, loads exceeding about half the nominal power of the crane are lifted by the block, the chain (or rope) being looped to the head of the jib, as shown in Fig. 2186 and other engravings.

Errors in specifications.—The following examples—amongst many which have come under the Writer's notice—are given merely in illustration of this branch of the subject :—

The first of these relates to cranes of the type Fig. 2172 which were required for discharging coal, ore and general cargo. The maximum load of 1½ tons was to be lifted at a speed of 200 feet per minute and rotated (slewed) at 395 feet. For the reasons above referred to, the extra cost involved in providing for these excessive speeds—so far as useful effect is concerned—is money wasted.

In another instance cranes similar to Fig. 2171, for dealing with coal and ore in the manner indicated in the engraving, were specified to fulfil the undernamed conditions :—

An average load of 10 tons was to be lifted at a speed of 120 feet per minute.
The speed of slewing to be 103 feet per minute.
The gantry to travel at a speed of 400 feet per minute.

It will be seen that these speeds are inconsistent with each other and involve an outlay which can be only very partially remunerative.

Test loads.—The only safe course is to provide the same margins of safety for the test load as would be provided for the maximum working load ; if the former is excessive it follows that the cost of the machine, freights, duties, etc., will be increased, with results which may be disadvantageous rather than otherwise. For these reasons a test load of 5 to 10 per cent. more than the maximum working load may be regarded as sufficient for all practical purposes. How far this falls short of some specifications is illustrated by the following abstract of one which has come under the Writer's notice.

Cranes of the type Fig. 2208, of 25 tons power and exceptionally long radius were to be tested with 50 per cent. beyond the maximum load, therefore with 37½ tons. After the load had been lifted and had remained suspended **during the Engineer's pleasure**, it was lowered by the brake and caught up by it three times during the process of lowering. It will be unnecessary to add that the cranes referred to are unnecessarily expensive and unwieldy.

The sole object in directing attention to this subject is to indicate that—with a genuine desire to protect the interests of purchasers, the opposite result is sometimes unintentionally attained.

Load in relation to radius.—As is well known, the proportions of a revolving crane must be in relation with the load and the radius of the jib. These conditions vary too widely to be tabulated, but an approximate estimate of the cost of a crane of almost any power and radius is easily made if the duty in **foot tons** is ascertained by the following rule :—

Add one sixth to the working load and multiply the product by the radius in feet ; reference is then made to the price (which will be found further on) of a crane of the type required and of the same power in foot tons, as indicated in the following example.

Assuming that a crane similar to Fig. 2195 is required to lift 2½ tons at 27 feet radius we have—according to the above rule—$2\frac{1}{2} + \frac{1}{6} \times 27 = 79$ foot tons. This is about the same duty in foot tons as 5 tons at 16 feet and the approximate price of the crane—as given at page —is £400.

Working expenses.—These necessarily vary with the type of crane, the kind and quantity of work performed in a given time, the prices of fuel, labour, etc. But from data obtained in England and from many European countries the cost of working high speed steam cranes of the types Fig. 2178 to 2196 is usually about 10 to 12 shillings per day. The cranes easily make 60 operations per hour, but if only 30 are made with aggregate loads of one ton—in or out—the cost of working is equivalent to only about one farthing per ton.

When loading or discharging ore, coal or general merchandise in European ports, the total cost of craneage, including labour on board and on quay, ranges from about 2 pence to 3½ pence per ton.

The working expenses **per ton lifted** being in proportion with the quantity dealt with in a given time, a higher tonnage rate than that referred to, must frequently be allowed for overhead travelling and other cranes of large power which are used intermittently or at relatively long intervals ; but the value of the services rendered by such cranes is so great, that the slight extra cost of working need not be considered.

Cost of maintenance.—If the minor repairs incidental to ordinary wear and tear—such as adjusting bearings and fittings, renewals of chains, etc.—are attended to by the driver, the Writer's experience indicates that 5 per cent. per annum is an ample allowance for repairs and renewals.

This is much below the rate generally accepted, but it is confirmed by information obtained from many users of cranes, and may be regarded as practically correct.

SYSTEMS OF CRANES.

The purposes for which these essentially "labour saving machines" are used vary so widely that each set of conditions needs careful examination. The system which will give the best results in working, maintenance, etc. is usually a matter of much more importance than the initial cost of plant because, if an installation is completely adapted for the work to be performed the interest on a relatively small difference in cost is quickly earned.

For these reasons the tendency in recent years has been to build cranes with special reference to the work for which they are required, rather than to attempt to adapt each crane for a wide range of power, and the following remarks are merely intended to convey a general indication of the purposes for which each system seems to be best adapted.

ROTATING STEAM CRANES, complete with engines, boiler, etc. are used with equal advantage singly, in isolated positions or in groups, and no other type of lifting machinery provides so many combinations of speed and power—all available for instant use—and arranged to give the maximum useful effect.

Quick working cranes such as those illustrated at pages 44 to 52 for working loads up to about 3 tons usually have single purchase gear only, whilst those of greater power have double and treble purchase, so that in all cases the speeds of working coincide as nearly as possible with those requisite for dealing economically with the loads for which the cranes have been designed.

Locomotive cranes.—As is seen in iron and steel works, foundries, railway goods depôts, Docks, Works of construction, etc.—where the cranes are employed alternately for hauling and for loading and discharging—the steam travelling motion has a value beyond all proportion to its cost.

Steam Derrick motion.—The same remark may be made with regard to appliances for instantly adjusting the radius of the jib to that most convenient for the time being.

HYDRAULIC CRANES.—Although an installation of hydraulic machinery may cost more and even be less economical in working expenses than some other systems would be, the facilities it affords for transmitting power through long distances, and some other considerations may well outweigh all others.

In this—as in all systems in which power is distributed from a generating station—the generating power and the hydraulic mains should have ample proportions for the maximum present demand, as well as for probable extensions.

The cost of working is naturally in proportion with the number of machines employed but, unless the conditions are exceptional, 12 machines seems to be about the minimum number that can be worked economically by the hydraulic system. For smaller installations it may be well to consider whether driving by steam or electric motor cannot be adopted.

ELECTRIC CRANES.—The use of electricity as a motive power is of comparatively recent date, but the results already obtained clearly indicate that the cost of working compares favourably with other systems. This feature, together with the facility with which power is transmitted in any direction and to almost any distance—the absence of noise, vibration, heat, etc.—must inevitably lead to the extended use of the electric system for driving cranes and many other machines.

It is interesting to note that builders and contractors, who so quickly recognise the value of appliances which afford facilities for the economical execution of their works, should be to a large extent the pioneers in adopting this system, just as they were years ago in the use of steam cranes.

CRANES DRIVEN BY COMPRESSED AIR, GAS AND OIL ENGINES have not hitherto given results which seem to recommend further development in any of these modes of working.

HAND POWER CRANES.—The power available being limited to that exerted by one, two or more men, with no margin—as in power driven cranes—to overcome resistances due to defects in construction, maintenance, etc., renders it all the more necessary that cranes worked by hand power should be of the best design and construction. The maximum duty obtainable from a given power must evidently be of far greater importance than the mere cost of the crane. This is often overlooked, but experience shows that the difference between a well and an ill designed crane is incredibly great—in some cases equal, or nearly so, to 1 man power.

Whether hand or power cranes should be used depends mainly on the cost of labour and the number of operations to be made in a given time.

In Arsenals and some other establishments where the time and cost of labour need not be considered or the work is intermittent, hand power frequently answers every purpose. But if 20 or more lifts per hour must be made, the decision is almost invariably in favour of steam, or some other form of power crane.

CRANES FOR DOCKS, QUAYS, &c.—The types in general use are referred to in detail in the following pages but for special installations accurate information should be given with regard to the nature of the traffic, the maximum dimensions of vessels to be provided for, and such other details as may be necessary for clear explanation of the conditions to be fulfilled. These vary very widely, but the following brief description of a small plant, for which the Writer is responsible, may perhaps serve as an indication of arrangements for similar undertakings in which—for various reasons—it is desired to add to the plant in proportion with the increase in traffic.

Tidal Harbours.—That now referred to is tidal; most of the steamers calling at irregular intervals and all wanting immediate dispatch. There is also a considerable coasting trade in minerals, merchandise, fruit, etc. and these services are provided for in the following manner:—

The ocean steamers are served by steam Gantry cranes of 5 tons power, similar to Fig. 2173, which afford perfect facilities for discharging and loading vessels on a rising tide, and as they all travel by steam power they can be easily concentrated, or distributed, to suit the exigencies of traffic. They also have steam Derrick motion for adjusting the jib to the radius most convenient for working ships of any beam.

The coasting vessels are principally small craft and the cranes are used almost exclusively for lowering from waggon or quay. A few portable hand power cranes equal to 2 ton loads, with quick motion for lifting the chain, of the type Fig. 2218, suffice for this duty; but there is a similar crane of 10 tons power for exceptional loads. All these cranes pass under the Gantry cranes and so circulate freely over all parts of the quay.

The goods warehouses are equipped with specially designed whip cranes which are modifications of that shown in Fig. 2213.

A 30 tons Derrick crane of the type Fig. 2233 will form part of the additions to plant to be provided later on.

Uniformity in design, &c.—It must be perfectly evident (although this is not seldom overlooked) that it is desirable to have the greatest possible uniformity in the construction and powers of cranes.

So large a proportion of the loads weigh less than 30 cwt. that—whatever system may be adopted—if the majority of the cranes are of 3 tons power, they have an ample margin for dealing with at least nine-tenths of the traffic ordinarily to be provided for and a few spare parts for renewals, will suffice to maintain the plant in thorough efficiency.

FLOATING CRANES.—Some data relating to floating cranes in successful use will be found in the following pages, but machinery of this kind varies so widely in power, radius, equipment, steaming capacity, &c. that full information thereon should be furnished for the guidance of the designer and constructor.

CRANES FOR WORKSHOPS.—The illustrations and description of **overhead travelling cranes, single rail cranes, forge and foundry cranes** and the other types referred to, furnish information relating to most kinds of cranes in common use in engineers' workshops. Those not referred to, come into the category of "Special Machines" which require special consideration.

TITAN AND GOLIATH CRANES.—It is convenient to refer to both these types of cranes together because the large blocks, now almost universally employed in the construction of harbours, docks, &c., can rarely be manipulated without a Goliath in the block making yard to place the block on the truck or trolley for transport to the Titan which places it in position.

The engravings, Fig. 2150 to 2160, represent types suitable for different modes of construction, but the variations in power, span, height and other proportions are so wide that machines of this kind must be specially designed for the work to be carried out. The indication of the cost, weight, &c., of the machinery referred to may, however, serve as a basis for estimating the approximate value of installations of other powers and proportions.

The cost of such machines may be reduced if the undercarriage is built in timber by the purchasers, the metallic superstructure and machinery being sent ready for erection. But in most cases this is doubtful economy where the cranes are exposed (probably for years) to constant changes of atmosphere and temperature.

STEAM TITAN CRANES.—The types in general use may be classified as follows:—

1—Titans (Fig. 2150) with traversing arm and motion for jennying longitudinally.
2—Titans (Fig. 2152) to jenney the load and rotate partially or completely.
3—Titans (Fig. 2154) to jenney the load with (or without) cross traversing motions.

Travelling motions.—All the above-named travel by steam power, but a hand power travelling motion is less expensive and sometimes answers every purpose.

Systems of construction.—A careful study of all the systems hitherto devised and of the results obtained in working, confirms the opinion that the construction indicated in Fig. 2152 possesses marked advantages in rigidity. Exception may be taken to solid web girders on account of wind pressure, but not the lattice type now advocated.

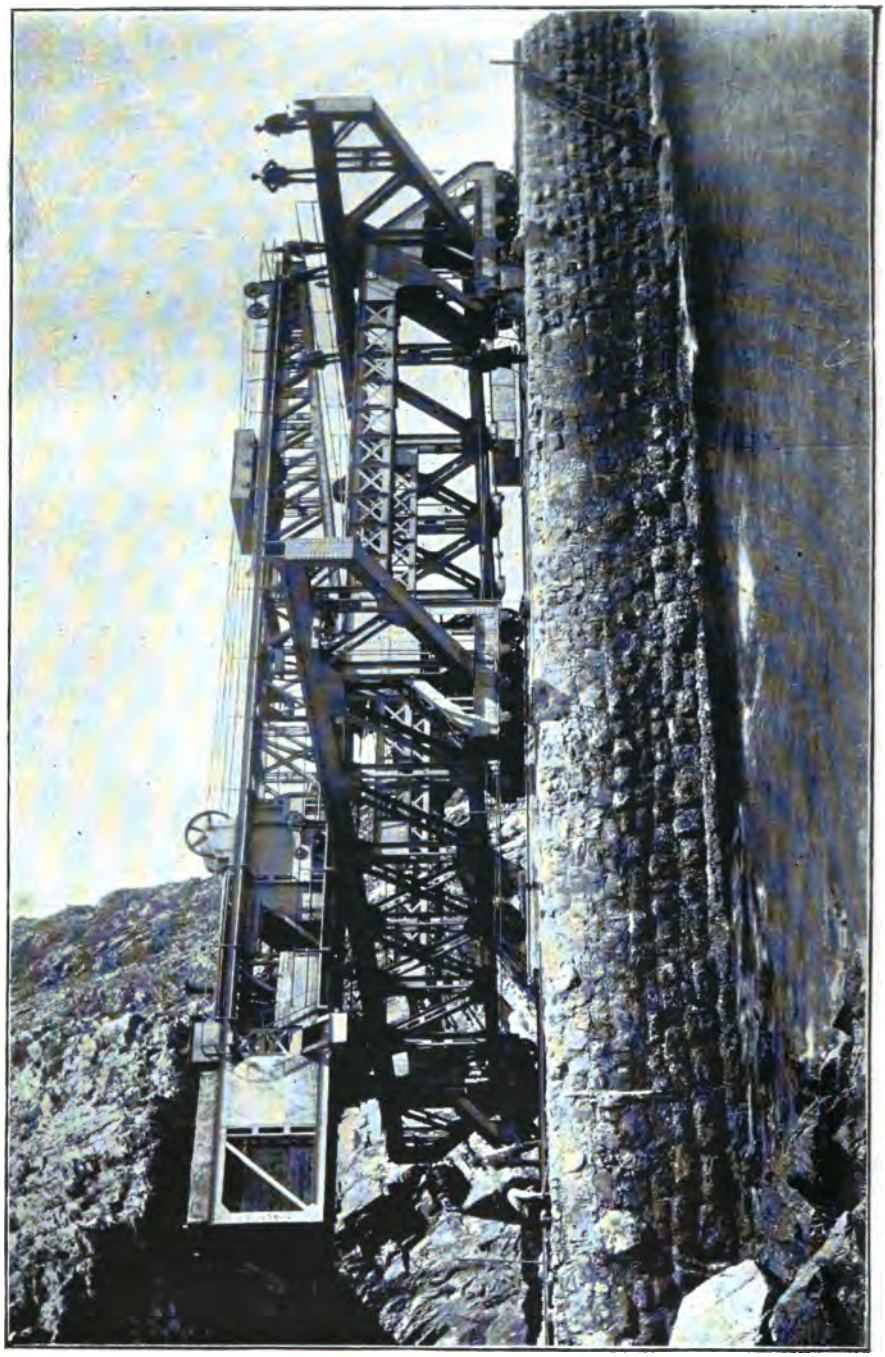


Fig 2150

Special designs.—Examples might be given of designs for Titans of other proportions and powers, up to 100 tons, but they have all differed in a greater or less degree—and even if space were available for engravings and descriptions of them—they would be of little practical value, seeing that all appliances of this type must be specially designed for the work they have to perform.

ELECTRIC TITAN CRANE OF 100 TONS POWER, see page 7)

TITAN OF 60 TONS POWER WITH TRAVERSING ARM.—Fig. 2150 represents a crane with a jib or cantilever, counter-weighted at the rear end, and provided with motions for lifting blocks weighing 60 tons and for traversing to place them within a range of 27 metres (about 98 feet 6 inches) transversely, and 12 metres (39 feet 4 inches) beyond the front of the undercarriage. This Titan, designed and built by the Author's firm was required for use in the formation of a mole and furnishes an example of need for the special consideration and construction mentioned in the foregoing remarks.

The conditions to be fulfilled are, generally as follows:—

(a) The Titan must complete several hundred feet of mole, the formation width of which is 27 metres (about 98 feet 6 inches), and place the 60 tons blocks at any point across the face of the work within a range of 12 metres (39 feet 4 inches) from the front wheels of the undercarriage.

(b) It must be capable of alteration to complete the outer end of the mole, which is slightly curved, and has a top formation width of 11 metres (about 36 feet) and,

(c) The travelling motions must be equal to moving the Titan back for shelter during the frequently recurring rough weather.

The blocks, and all materials used in the construction of the mole, must be brought by water, so that the only object in rotating the jibs would have been to command the whole face of the structure. It was found that this arrangement would be expensive and would involve difficulties in conversion to the narrower gauge eventually required and—after careful consideration—the cantilever system was adopted; this novel arrangement has proved to be completely successful.

The undercarriage is constructed of mild steel and is mounted on steel wheels with central flange and double treads which travel on two heavy steel rails on each side; these form a crane track 24 m 36 (equal to about 80 feet) centre to centre for the shore end of the mole, and provision is made in accordance with the condition (*b*) for eventually reducing the gauge to 8 m 36 (equal to about 27 feet) and for shortening the undercarriage to the same extent.

The travelling motion is transmitted from the main engines, by shafting and gear, to worm wheels on the axles of the double tread travelling wheels on each side of the undercarriage. Provision is made for complete lubrication and for adapting the travelling motion to the reduced span of 27 feet. The levers controlling this motion are worked from the main platform and the Titan is quickly moved into a sheltered position when necessary.

The traversing arm, or jib, also built of mild steel, is of the length necessary to fulfil condition (*a*). The lower members of the two main girders are connected back and front, by strong steel girders; these carry the machinery for cross traversing which consists of turned steel rollers with the necessary gear driven from the main engines and controlled by levers alongside those for the other motions.

The "jenney" cradle for traversing the load along the jib is mounted on steel wheels and is worked by flexible steel wire rope in the manner usually adopted in modern practise.

The Machinery, engine, boiler, feed water tank, &c., enclosed in a house with ample space for fuel, are fixed about centrally on the jib, in front of the counterweight which (in this instance) is in concrete moulded in place.

The levers, signalling gear, &c. are so arranged that all operations are easily controlled by one man. A gangway extends from the machinery platform to the end of the jib and signals are transmitted, from any part of this platform by an electric conductor, to an indicator in front of the attendant in charge of the levers.

Longitudinal and cross traverse.—As will be seen from the engraving and the foregoing description, by means of these motions the arm commands the entire face of both wide and narrow formations, and admits of the work being carried out under the most favourable conditions in regard to cost of construction and initial outlay on plant.

The approximate cost of the Titan is .. .. £8500.

The cost of packing for shipment and delivery f o.b. is about 2½ per cent. and the weight, in working order is about 320 tons, or including counterweight, about 380 tons.

Fig. 2151A

TITAN, OF 55 TONS POWER, TO LIFT, ROTATE, TRAVERSE THE LOAD, AND TRAVEL BY STEAM POWER.—The Crane (fig. 2151A) has a radius of 13 metres (about 42ft. 8in) and travels on a gauge of 5m. 790 (about 19 feet), and is used in conjunction with the concrete mixers, crushers, screens, lifts, surface condensing engine, shafting, etc , referred to in Section V.

The conditions to be fulfilled are the reverse of those last referred to, inasmuch as the blocks are made at a considerable distance from the mole and are hauled by locomotive. Local traffic frequently interferes with the passage of the locomotive and block truck, and as there is no space on the mole for storage of blocks, the crane must be able to take the block off the truck and lay it in position without re-handling.

To fulfil these conditions the jib must rotate through a complete circle in either direction, pick up its load at any point within its length and traverse and lay all the blocks, including the outer foundation blocks ; it must also frequently travel with the load.

The normal speeds of working are—

Lifting 55 tons, 3ft. 3in. per minute, or light loads at 20 feet.
Traversing the load, 26 feet per minute.
Travelling (with or without load) 20 feet per minute.
Rotating or "slewing," 27 feet per minute at the end of the jib.

The Gantry, undercarriage, and rotating jib are built of mild steel and, as indicated in the engraving, the upper frame is supported on columns of box section which are mounted on two undercarriages. each fitted with steel axles and double tread chilled iron wheels with central flanges and the necessary propelling gear. The centre pivot, around which the jib rotates, is a steel forging, bored and fitted to receive the shaft by which the travelling motion is transmitted, and is fixed in a massive central block supported on all sides by box girders in the upper frame.

Machinery.—The boiler and engines which drive the lifting, jennying, slewing and travelling motions are fixed in the position indicated in the engraving, the floor is of wrought iron chequered plate, and the levers controlling the several motions are side by side in the engine room in a position which affords the driver a clear view of the work.

The engines have case-hardened link-reversing motion and all usual fittings and accessories. There are two speeds of lifting (3ft. 3in. and 20ft. per minute) and the main spur wheels for lifting are keyed direct on the ends of the rope drum ; a brake is provided, which sustains the maximum load in any position. The rope drum is grooved spirally to left and right hand to coil at each end and sufficient best flexible steel wire rope is provided to lower the 55-ton blocks by four effective falls from each end (8 ropes in all) to a depth of 40 feet below rail level. The shafts are of steel and carried in hard gun-metal bearings, the pinions are of cast steel and the wheels are shrouded to pitch line.

The jenney is traversed in both directions by positive motion ; the carriage is mounted on double flanged steel travelling wheels, steel axles and gun-metal bearings ; the rope sheaves are bushed with gun-metal.

The approximate price of the Titan, with forged steel lifting beam and T head lifting bars, best flexible steel wire rope and block, with steel cross head and live ring is about £5000. The total weight is about 152 tons, and the approximate cost of packing for shipment and delivery f.o.b. is 3 per cent.

TITAN, OF 30 TONS POWER, TO LIFT, ROTATE, TRAVERSE THE LOAD, AND TRAVEL BY STEAM.—The crane is similar in design and span to Fig. 2151A, but with a range of traverse on the jib of 50 feet, and to lower the load within a range of 55 feet below the crane track.

The cost of the crane with working speeds in relation with those last referred to is about £3750

The approximate weight is 110 tons, and the cost of packing for shipment and delivery f.o.b. is 3 per cent.

TITAN OF 20 TONS POWER, and motions as above, and a range of traverse of 22 feet, costs £2600

The weight is about 78 tons, and the cost of packing, etc. about 4 per cent.

GRAB DREDGING.—Appliances for this purpose were not required in connection with the cranes above referred to, but they are frequently invaluable for levelling the bottom and for other purposes.

Single chain grab dredgers, of any of the types illustrated by Figs. 2237 to 2248 are easily applied and the approximate price of the grab will be ascertained by reference to pages 94 to 98 ; adding the cost of the gear for working it, the total will probably vary from £175 to £275.

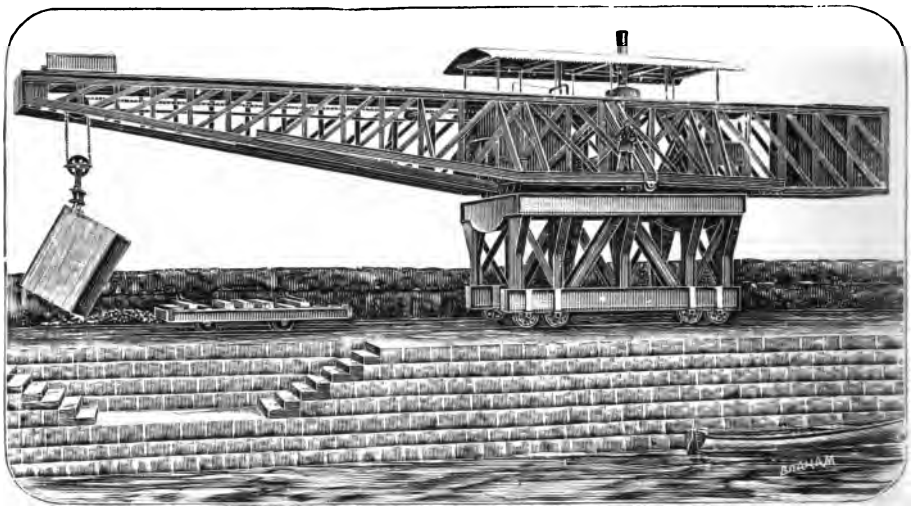


Fig. 2152.

TITAN WITH STEAM ROTATING, TRAVERSING AND TRAVELLING MOTIONS.—The engraving represents a crane of 35 tons power and is typical of others designed and built by the Writer's firm.

Work performed.—The crane referred to was required to be capable of laying eight blocks per day, but it has frequently dealt with fourteen and, after more than ten years continuous work, no repairs or renewals have been required excepting those due to ordinary "wear and tear," such as renewals of chains, bearings and some small gear.

Leading dimensions.—The span of the undercarriage is about 18 feet and the height about 14 feet above rails. The load of 35 tons is traversed 40 feet, and the jib makes a complete revolution in either direction without reversing the engines. The cost of the Titan would have been reduced if the arm had been arranged to rotate through only a portion of a circle, but the facilities afforded by describing a complete revolution were found to outweigh the relatively small difference in cost.

The jib is built of mild steel and the jenney traverses through a range of 40 feet. The lower members of the jib are tied together by girders fore and aft, and carry turned steel anti-friction rollers which bear on a forged steel conical roller path. The rollers are driven from the main engines by shafting and gear, in the usual manner.

In other cases the turning motion is transmitted by a pinion gearing into a spur ring around which a number of cast steel or chilled iron rollers are arranged to form a "live ring"; either system seems to be equally satisfactory.

The undercarriage is built of wrought iron and is mounted on steel wheels with central flange and double treads; the power for travelling is transmitted from the main engines on the machinery platform. A separate pair of engines is however sometimes provided for the rotating and travelling motions. This simplifies the arrangement of gear but involves a slight increase in cost.

The machinery consists of a pair of engines with case hardened link reversing gear and all appliances for lifting, lowering by steam or by brake, traversing the load and for rotating and travelling. Two speeds are provided for each operation for use, respectively, for the maximum duty and for working the block slings or other light loads. The whole of the machinery, including the boiler, feed water tank, &c., is fixed on a platform between the two main girders which form the revolving arm and protected by a galvanized iron canopy with curtains at sides and back.

The concrete counterweight to equalise the strains, under widely differing working conditions, is enclosed in the wrought iron box at the rear end of the jib.

The levers controlling all motions are side by side and arranged to give the driver a clear view of the dial indicator which is worked by the superintendent, from any part of the platform which extends to the end of the jib.

The Titan track is about 18 feet gauge and consists of two heavy steel rails of Vignolles section laid at the proper distance apart, to take the double treads of the travelling wheels. But when the crane is at work, both rails and travelling wheels are relieved from strain by massive blocks at each corner of the undercarriage, adjusted by screws to take a bearing on the permanent masonry, or on heavy cast iron temporary stools, as the case may be.

Grab gear can be arranged as described below, and at same cost.

The approximate price of the Titan, Fig. 2152, is .. .. £4000.

The weight in working order is about 195 tons, but this is materially reduced when the counterweight is deducted. The total weight will, however, serve as a basis for estimating the cost of freight, due allowance being made for measurement and shipping charges.

TITAN OF 30 TONS POWER.—This crane is generally similar to that shown in Fig. 2152, but exceptional conditions involved the modifications and additions now briefly described.

The undercarriage is built of mild steel and has a clear height of 14 feet 3 inches above rails; the span, when at work, is 18 feet, but travelling gear is provided for a span of 14 feet or 18 feet. This break of gauge is necessary to admit of traversing over a considerable length of existing work which could not be increased in width without heavy additional expense.

The revolving arm is of lattice construction and is supported on a live ring and steel roller path and internal rack for slewing. The 30 tons blocks are traversed and deposited through a range of 40 feet and electric signalling apparatus to the engine room is controlled from any part of the jib.

Grab dredging gear.—The front end of the jib is provided with the appliances for carrying a grab of the type Fig. 2238, for use in levelling the bottom to receive the blocks, passing down grout, &c. Separate high speed gear is fixed in the engine room for working the grab independently of the Titan motions.

Electric lighting installation.—The working season, during which blocks could be laid, was so limited that it was found necessary to work continuously and—for this purpose—a complete electric lighting installation was erected in the engine room.

A special engine, supplied with steam from the main boiler, is coupled to the dynamo spindle. Incandescent lights are used where suitable and, in addition to these, a specially designed lamp projects a beam of light in the direction required, as indicated by signal by the diver.

The cost of the plant is approximately as follows:—

The Titan with travelling gear for two gauges	£3600.
The grab and appliances for working it	£260.
The electric lighting installation	£300.

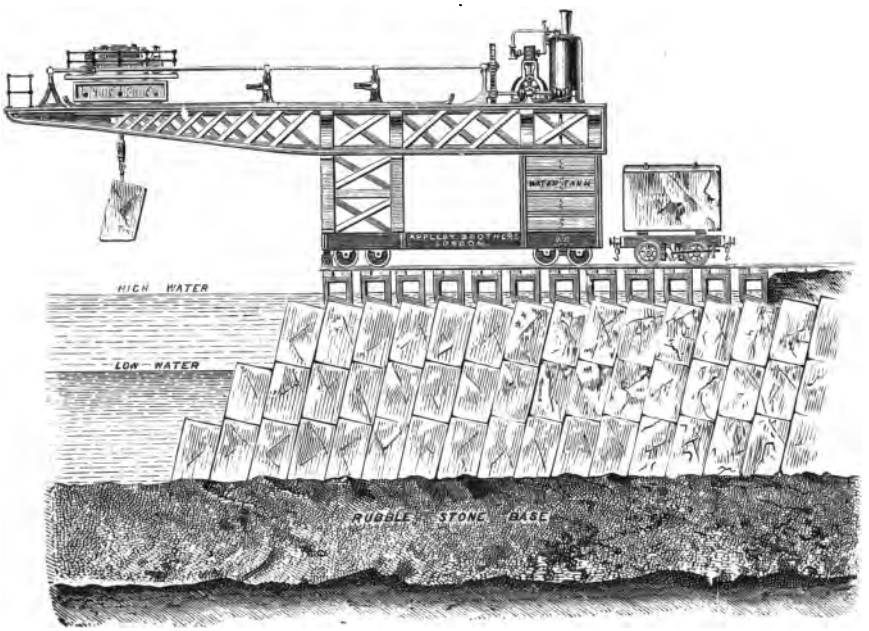


Fig. 2154

TITAN WITH LONGITUDINAL AND CROSS TRAVERSING MOTIONS.—The early type of machinery of this kind, represented by Fig. 2154, has been constructed for various powers and dimensions; the undercarriage has in some cases been built of timber, but wrought iron or steel is generally found more suitable.

The crane illustrated is of 25 tons power, the span is 22 feet, and blocks are deposited at any point within about 25 feet from the front wheels of the undercarriage; the cross traverse has a range of 20 feet.

The travelling gantry has a clear height above rails to admit the block truck and block to pass under it and within range of the lifting chain. The traversing motions transmit the load to the position required across the face of the work.

The lifting and traversing machinery is similar to that of an overhead travelling crane. The motions for lifting and for traversing longitudinally and transversely are transmitted from the engines by the line of shaft, supported on tumbler bearings, shown in the engraving. The reversing motions for all operations, whether in slow or quick speed, are effected by powerful double-ended friction clutches on the crab, and these. as well as the brake lever, are controlled by the driver. If the gantry must travel by its own steam power the engines are fitted with case-hardened link motions, but this gear need not be used for other purposes.

Counterweight.—This is provided by a water tank between the vertical supports at each side of the rear end of the gantry but, concrete blocks have been used with advantage, in lieu of water ballast.

The price of the crane without locomotive motion, delivered on trucks is about £2500.

The approximate weight is 90 tons, exclusive of counterweight.

CONCRETE MIXERS, BLOCK TRUCKS, &c.—Detailed reference to these and other kinds of block yard plant will be found in Section V.

ELECTRIC—HYDRAULIC BLOCK LOADING GANTRY OF 100 TONS POWER, see page 71

Fig. 2155.

BLOCK LOADING GANTRY OF 80 TONS POWER.—Fig. 2155 represents a portion of the plant employed in connection with the Titan Fig. 2150. The block is placed on a specially constructed truck, by a Goliath of the type Fig. 2157 and hauled from the block making yard, by locomotive, to the gantry shown in the engraving.

The loading machinery consists of a hydraulic ram and cylinder with a stroke of 20 feet and equal to a working load of 80 tons. The lower end of the cylinder is arranged to adjust itself automatically to ensure the lifting strains being concentric with the axis of the ram, and to remain vertical so soon as the block is clear of the truck, ready for traversing and lowering. The lower end of the ram is provided with appliances for swivelling and adjusting the block to the position desired in the barge. Pressure to the cylinder is supplied by a set of hydraulic pumps driven by the steam engine and boiler. This machinery is carried on a travelling carriage built of steel girders and mounted on steel wheels with travelling gear driven from the engines.

The cantilever girders which carry this machinery are secured to masonry walls, with space between them for the passage of the block truck, and extend backward about 35 feet, the girders overhang about 26 feet which gives a traverse of nearly 60 feet.

The block is lifted by the ram and traversed out until in the position desired for lowering into the barge (not shown in the engraving) for conveyance to the Titan.

The cost of this block loader as illustrated (exclusive of masonry) is about .. £1300.
The machinery only (exclusive of girders) is worth about .. .. £700.

Fig. 2156.

BLOCK LOADING GANTRY OF 40 TONS POWER. — The conditions as regards the distance from the block making yard and the point of delivery are similar to those last described but—in this case—arrangements had to be made for handling blocks arriving at a right angle with the shipping gantry. This consists of a pair of wrought iron girders fixed on timber uprights and projecting about 15 feet beyond the dock wall, the ends being supported by struts as shown in the engraving Fig. 2156.

The block is lifted, traversed and lowered, by an overhead steam travelling crane on to a side tipping truck below, and is hauled by a locomotive over a narrow gauge temporary line laid on the floor of the dock. This line extends to the breakwater where the blocks are deposited in "pierres perdues."

The simple arrangement above referred to answered quite well for the temporary purpose for which it was designed, and the machinery and ironwork serve for the more permanent work on which it is now employed.

The cost of the machinery and ironwork is about .. .. £1200.

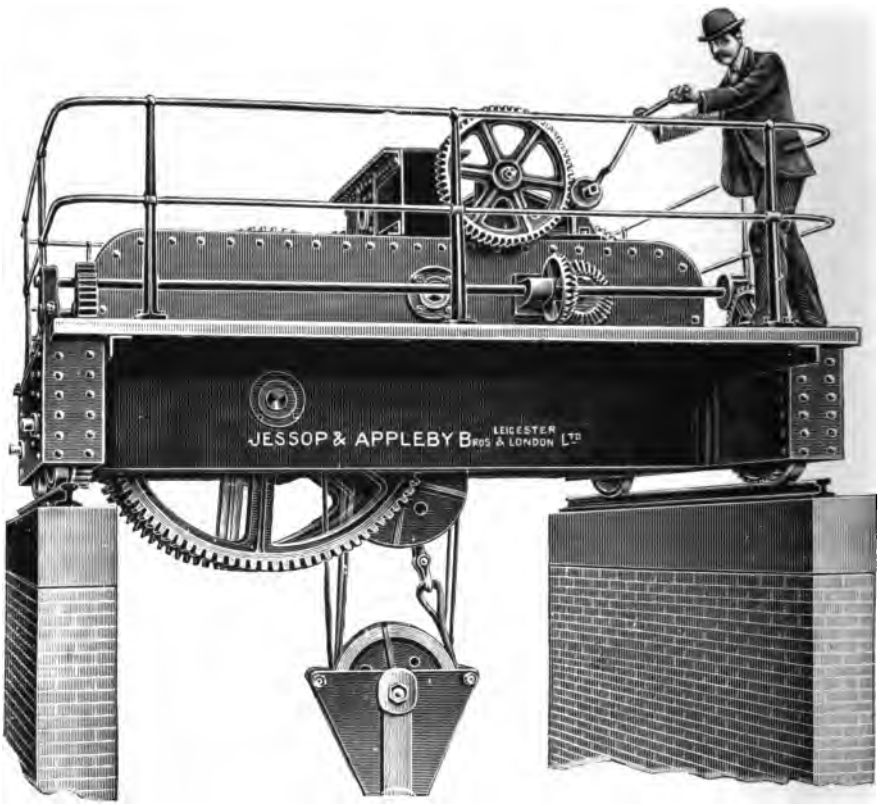


Fig. 2156A.

PORTABLE HAND-POWER CRABS, similar to Fig. 2156A, are constructed of any power or span, and are usefully employed for many purposes. The crab illustrated was specially designed for lowering concrete blocks which had been placed on trucks in the block-making yard, by a steam Goliath Crane, Fig. 2157A, to be finally set by the Floating Crane of the type Fig. 2166; the longitudinal travelling motion was required for accurately adjusting the position of the block when lowered out.

The travelling crab has three purchases and consists of a pair of cast iron side frames fixed on girders constructed of steel plates and angles which carry the gear for lifting and travelling. The bearings for the first and second motion shafts are in the cast iron side frames; those for the third motion and barrel shaft and for the travelling gear are attached to the main girders.

The end cradles, which connect the main girders, are of box section, and are provided with bearings for the double flanged travelling wheels and the gear for driving them. The travelling motion is transmitted from the crab by gear which gives motion through the transverse shaft and so to the wheels in both end cradles.

The rope barrel is grooved spirally to coil steel wire rope for lowering to a depth of 33ft. and the main wheels are keyed direct on the ends of the rope barrel to relieve the shaft of torsion. The pinions are of cast steel and the crab is fitted with screw brake, steel pawl wheel and hardened steel pawl.

The rope sheaves revolve on a turned steel shaft in the box girder fixed to the main beams. The bottom block has steel plate sides and swivelling loop with side plates for attachment with a lifting beam, as shown in Fig. 2157A.

The price of the travelling crab, of 45 tons power, with best flexible steel wire rope, platform, handrails, etc. is about £350

Travelling crabs of other proportions naturally vary in design, but, as above indicated, they are built to fulfil any conditions in regard to lifting power, span, etc.

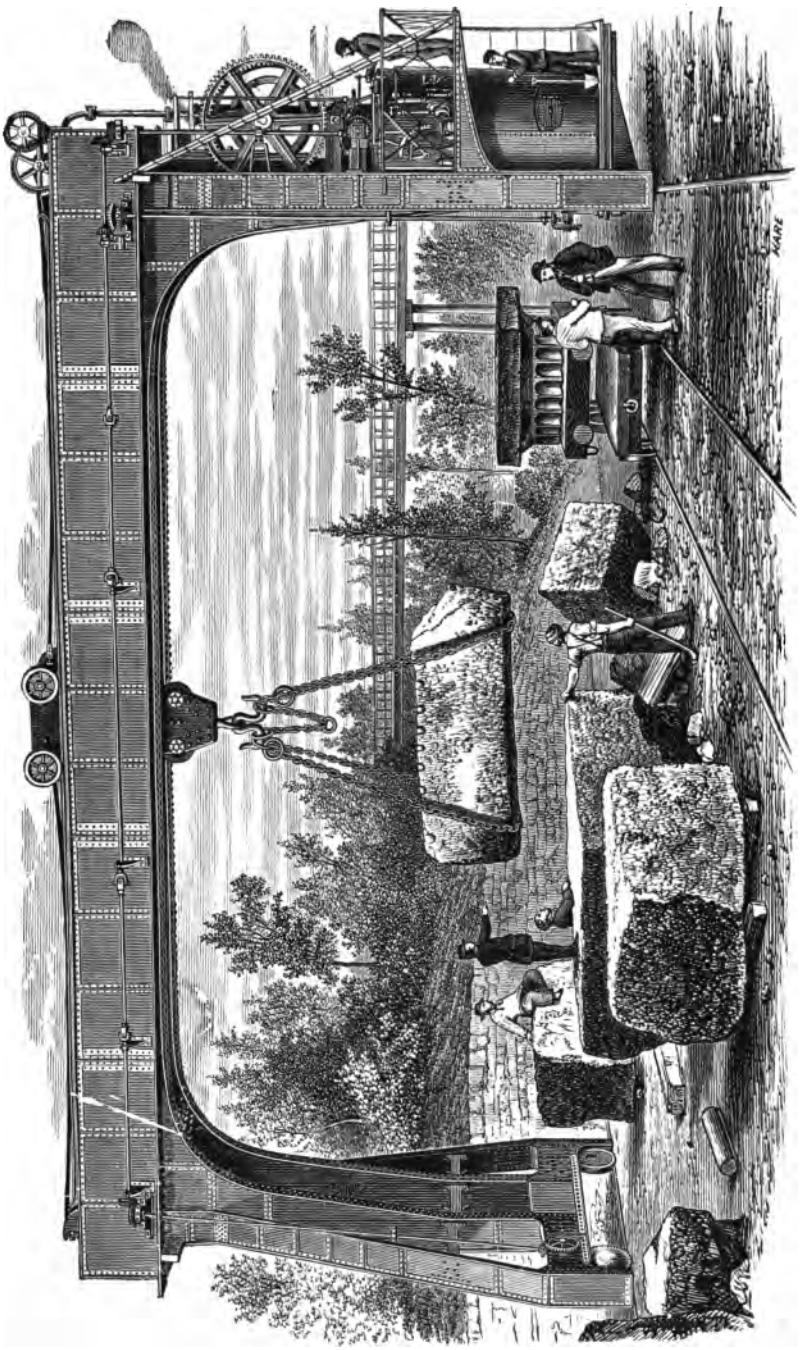


Fig. 2157

GOLIATH CRANES.—As already indicated, these are almost indispensable or manipulating large blocks of stone or concrete, whether in quarries or in the formation of docks, piers and similar work, and they are scarcely less so for dealing with loads of exceptional weight and bulk in railway goods stations, arsenals and locomotive works.

There is scarcely a limit to the power and dimensions for which cranes of this type are constructed, or to the arrangements of the machinery for lifting and for cross and longitudinal traverse, but the following examples indicate a few of the conditions they have fulfilled.

In some cases the Goliath is used in lieu of—or perhaps, more profitably, in connection with—overhead travelling cranes in erecting shops, bridge and boiler works, &c. Where both kinds are provided, the overhead traveller is left free for service over the whole area within the limits of the longitudinal rails, whilst the Goliath (beneath it) is used for other work, and more especially that which requires to be suspended for a considerable time.

Mode of working.—Whatever system is adopted (steam, hydraulic, hand or other power) the machinery is easily arranged to be worked from the platform or from the ground level. In block making yards the space between the lines of blocks is, usually, so limited that the machinery is carried on the main beams, as shown in Figs. 2158 and 2159; for other purposes it is frequently more convenient to work all motions from (or near) ground level. As indicated above either arrangement is easily carried out and the difference in cost is quite unimportant.

GOLIATH, STEAM CRANE OF 40 TONS POWER, WITH CROSS TRAVERSE AND LONGITUDINAL TRAVELLING MOTIONS.—Fig. 2157 represents a crane of this power and 40 feet span, with a clear height of 22 feet above rail level.

The lifting cross and longitudinal traverse motion, in quick and slow speeds, are transmitted from the engine and gear carried on the side frames, and all motions are controlled from the driver's platform. The ends of the under-carriages are arranged for blocking when heavy loads are lifted.

The approximate cost of the crane is £1875

The weight is about 60 tons, and if shipped in pieces of convenient weight, the cost of packing and delivery f.o.b. is about 4 per cent.

A Goliath of 20 tons power, similar in arrangement to that illustrated, with a span of 35 feet, costs about .. .. £875 and the approximate weight is 28 tons.

GOLIATH STEAM CRANE OF 50 TONS POWER WITH CROSS TRAVERSE AND LONGITUDINAL TRAVELLING MOTIONS.—Fig. 2157A represents a crane which forms a portion of the plant, designed and built by the writer's firm, for making and handling the concrete blocks required for the Harbour Works constructed by Her Majesty's Government at Gibraltar.

The crab traversing the main beams transmits power for working the abovenamed motions and all are controlled from the driver's platform.

The Block Ground Plant consists of three of the cranes illustrated which lift, load and stack the blocks; a fixed Gantry with two sets of machinery, each to carry a working load of 40 tons, for placing the blocks on barges, all appliances for swinging and swivelling them, block trucks with swivelling bogies built of steel and mounted on twelve wheels with steel axles, springs, draw gears and brakes, small cranes for the block yard, etc.

Three roads (one for each line of blocks) converge at the shipping Gantry and each road is provided with a Goliath (Fig. 2157A); the leading dimensions are

Gauge of longitudinal track	35 feet
Cross traverse of load	35 ,,
Height of lift (3 feet below and 16 feet above rail level)	19 ,,
Ordinary working load	40 tons

The test load of 50 tons was dealt with at the following speeds:

Lifting	6 feet per minute
Longitudinal travelling ..	88 ,, ,,
Cross traversing	22 ,, ,,

High speeds for each motion are provided for working with loads up to 10 tons.

The crab, boiler and feed water tank are fixed on a platform constructed of steel girders and fitted with flanged steel travelling wheels, steel axles, gun-metal bearings, etc. The crab side frames are formed of pairs of steel plates and carry the engines with case-hardened, link-reversing motions and long gun-metal bearings for all journals; also a powerful hydraulic brake which sustains the test load, a second (strap) brake is provided for lowering loads up to 10 tons. The lifting gear is treble purchase, the lifting barrel is grooved spirally and carries flexible steel wire rope for the maximum lift without overlap. The platform around the crab is decked with timber and surrounded by hand railing and a galvanised iron house.

The Gantry is built of mild steel in conformity with the usual Admiralty tests for materials, workmanship, margins of safety, etc.

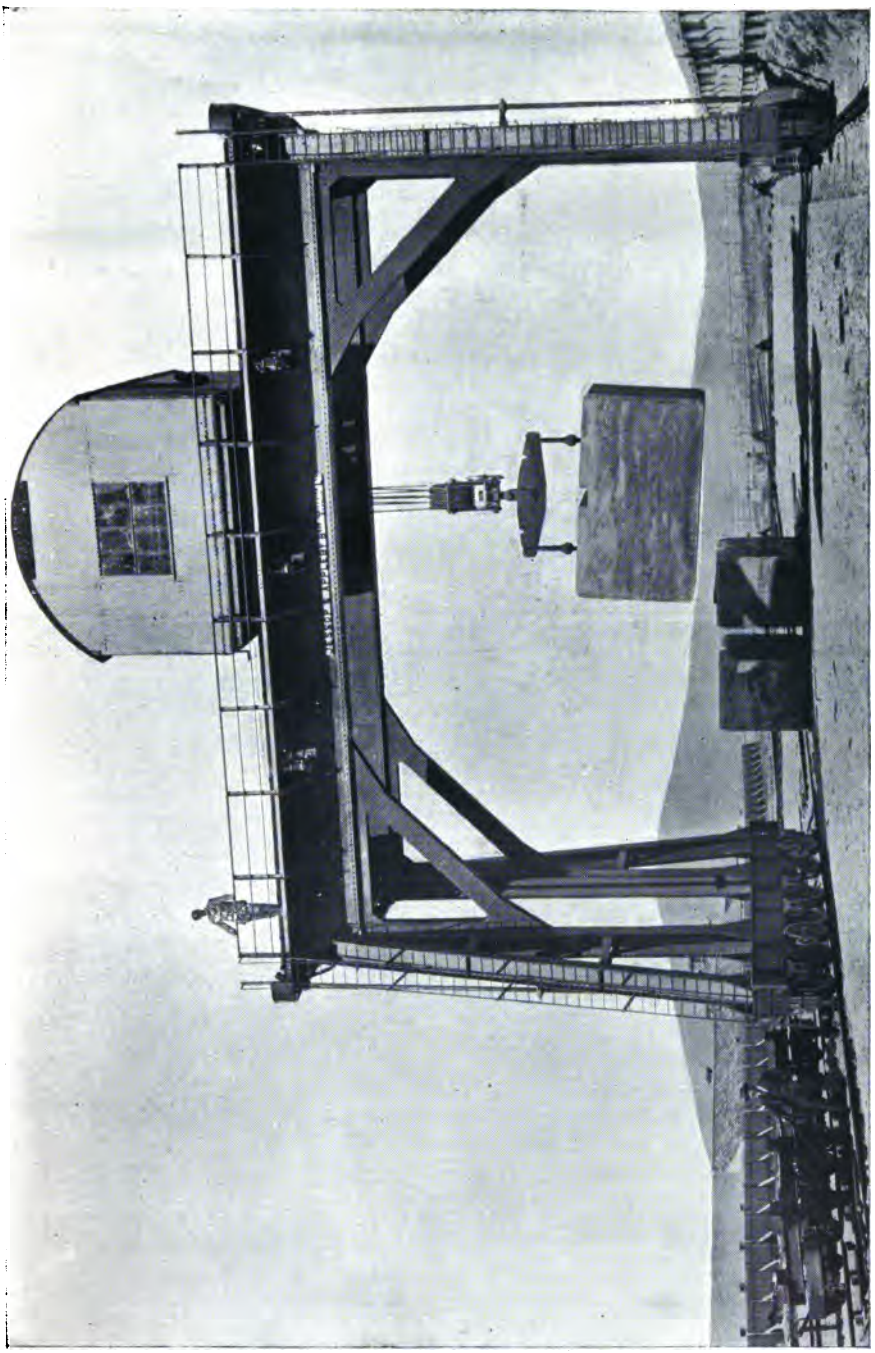


Fig. 2157A

The main girders, uprights of end frames, and the girders forming the under carriages, are of box section. The latter are fitted with steel tyred travelling wheels and steel axles, and are driven by gear on each side, power being transmitted from the crab The axle boxes, with hard gun-metal bearings, slide in heavy brackets and each wheel is carried on steel springs.

The approximate cost of the crane is £3150

The total weight is about 100 tons and the cost of packing for shipment and delivery f.o.b. is about 4 per cent.

GOLIATH, STEAM CRANE OF 45 TONS POWER, WITH CROSS TRAVERSE, LONGITUDINAL AND TRANSVERSE TRAVELLING MOTIONS.—A crane of the above-named power, the Floating Crane, Fig. 2166, and the Hand-power lowering Crab, Fig. 2156A, comprise the plant supplied to a foreign Government for manipulating concrete blocks.

The working speeds of this Goliath are so nearly the same as those last referred to (Fig. 2157A) that they need not be repeated. But it was necessary to devise a transverse travelling motion to completely adapt the crane for the block-making ground on which it works.

The transverse travelling motion is required because in the space available for block-making there is not length enough for the front blocks to be ready for removal by the time those at the far end have been made.

The traversing appliances to meet this difficulty consist of a set of gear, worked from the crab, which lifts the Goliath and travels it on another track at a right angle on which the crane has worked, leaving the crane ready for moving the finished blocks between the lines of rails to which it has been transferred.

The price of this crane, exclusive of the transverse travelling gear (which is rarely wanted), is about £2300

The extra cost of the jacking and transverse travelling motion is about £150.

The approximate weight is 70 tons, and the cost of packing for shipment and delivery f.o.b. is about 4 per cent.

Spare parts.—As the crane is for service where (for some time to come) there will be no facility for renewals, the under-named spare parts are provided ready for use in case of need: A complete set of gun-metal bearings and steel pinions; a set of link motion gear, fitted complete; three sets of piston rings; a pair of valve rods and a set of gun-metal gland bushes; valves, plunger, piston rings and gun-metal fittings for steam feed pump; a steam pressure gauge; two dozen gauge glasses and rings; two sets of fire bars.

GOLIATH, STEAM CRANE OF 30 TONS POWER, WITH CROSS TRAVERSE AND LONGITUDINAL TRAVELLING MOTIONS, similar in construction to Fig 2157A, but for a span of 50 feet costs about £1950

The approximate weight is 50 tons, and the cost of packing for shipment and delivery f.o.b. is 4 per cent.

GOLIATH STEAM CRANE OF 20 TONS POWER, similar to that last referred to but to span 40 feet, costs about £950, and the approximate weight is 28 tons.

A Goliath to lift 10 tons by steam power and span 40 feet, costs about .. £690 and weighs about 20 tons in working order.

TIMBER FRAMED GOLIATH TO LIFT 40 TONS BY STEAM POWER.—The whole of the framework is constructed of timber firmly secured by bolts and plates, the end travelling carriages only being formed of wrought iron box girders.

The span is 14 feet and the clear height above rails is 12 feet; the machinery for the lifting and traversing motions, with boiler, &c., is carried on the main beams and covered by a canopy. The travelling motion is transmitted to the double tread steel wheels by shaft and suitable gear.

The cost of the crane is about .. .. £1450 and the weight is about 55 tons.

This crane has done good service for several years in the construction of harbour works, but, as mentioned elsewhere, it is doubtful whether a timber structure, however well designed and built, will be quite as satisfactory as one built in wrought iron or steel, whilst the difference in cost seems to be too small to be worthy of serious consideration.

GOLIATHS WORKED BY HYDRAULIC POWER.—The travelling carriage is usually similar to that shown in Fig. 2158, but the lifting appliances consist of one or more hydraulic cylinders and rams with compensating motion to avoid side strains. The pressure (about 2000 lbs. per square inch) is supplied by a set of hydraulic pumps driven by a pair of engines which also provide the power for traversing, all motions being controlled by one man.

Goliaths of this construction have been built of all powers up to 80 tons. The cost is about the same as for cranes of the type Fig 2157 similar power and proportions.

ELECTRIC—HYDRAULIC GOLIATH (see pages 70 and 71).

GOLIATH CRANES WORKED BY ELECTRIC MOTORS — Goliaths of any of the types referred to but provided with an electric motor in lieu of the steam engine, &c. shown in Fig. 2157, do not vary widely in cost from one of equal proportions worked by steam power.

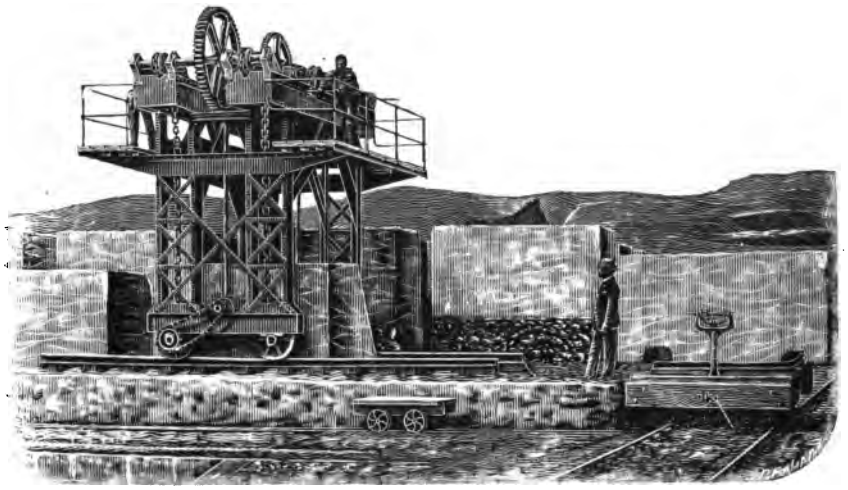


Fig. 2158.

HAND POWER GOLIATH TO LIFT 40 TONS.—The crane Fig. 2158 (sometimes called a "Camel") works in conjunction with the Titan Fig. 2152.

The undercarriage is of wrought iron and has a span of 11 feet and a height of 10 feet in the clear; the travelling wheels are in cast steel and motion is transmitted to them from gear on the lifting crab.

The lifting machinery is fixed on the main cross beams and surrounded by a platform which gives ample space for working; there are two speeds for lifting and traversing and both motions are worked from this platform.

The Goliath passes between the lines of blocks and carries the suspended block to the block truck, shown on the right, ready for hauling to the Titan.

The cost of the Goliath is about £550
and the total weight about 20 tons.

THE BLOCK TRUCK is built of steel with steel wheels and axles and heavy gun metal bearings. The cost is about .. .. £120.

HAND POWER GOLIATH TO LIFT 45 TONS—The simple but efficient crane illustrated by Fig. 2159 was designed to lift and travel with blocks for the most part exceeding 40 tons weight. The works are of comparatively small extent and—for this reason—it was desirable, as far as possible, to limit the outlay for plant.

The travelling gantry is constructed of steel and has a span of 6 feet 6 inches and a clear height of 11 feet 6 inches It is mounted on double flanged steel wheels and motion for travelling is transmitted to them by a pitch chain, on each side, driven from the crab.

The lifting machinery has treble purchase gear carried on the main beams and is surrounded by a timber platform. The lifting bar is of steel and the chain sheaves work on turned steel pins. The several parts are bolted together and marked for re-erection.

The price of the crane with chains, lifting bar, &c, is £255

THE BLOCK TRUCK is built of steel and costs, with hand power travelling gear and double crank handles, about .. .. £120.

PORTABLE HAND POWER GOLIATHS WITH WROUGHT IRON FRAMES.—The general arrangement, and the equipment of lifting and travelling gear, so closely resembles that indicated in Fig. 2160, that a separate illustration is superfluous. It will be understood that in wrought iron structures of this kind the main beams are not usually trussed.

PRICES OF PORTABLE WROUGHT IRON HAND POWER GOLIATHS.

Power of crane ..	tons	5	10	15	20	25
Span	feet	30	30	30	30	30
Height	,,	14	14	14	14	14
Price of crane	..	£275	£375	£475	£550	£670
Approximate weight ..	tons	9	13	16½	21	30

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

Fig. 2159.

GOLIATHS FOR LOCOMOTIVE SHOPS (and for some other purposes) are frequently required to carry two crabs for facility in erecting or repairs. If this arrangement is adopted allowances must be made for the cost of the additional crab. For approximate estimate, the price may be assumed to be about 10 per cent. more than that of a crane of equal power, with one crab.

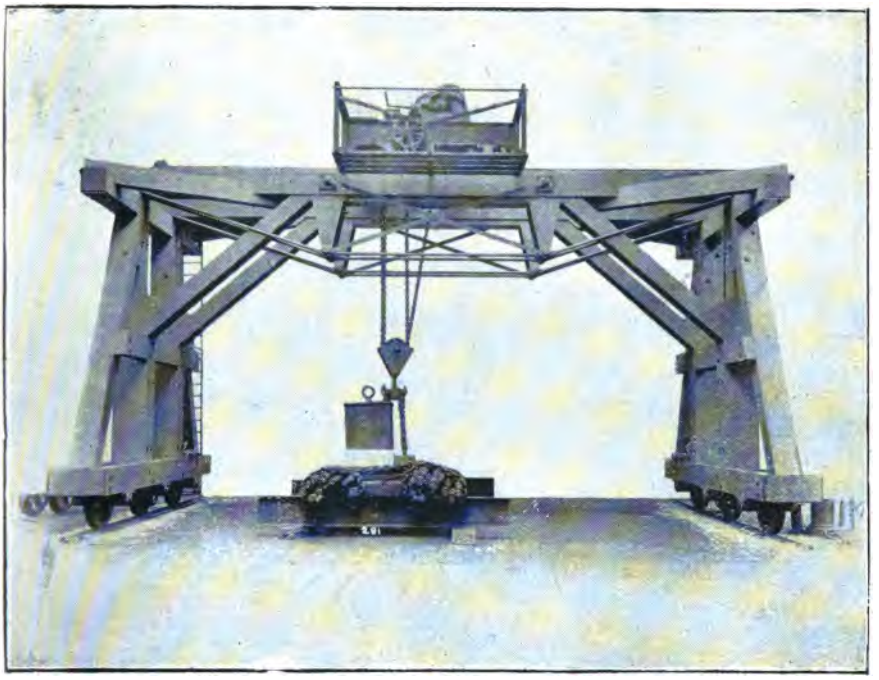


Fig. 2160.

PORTABLE HAND POWER GOLIATHS WITH TIMBER FRAMES.—Fig. 2160 illustrates a crane of 20 tons power and 30 feet span built for a Colonial Government and is typical of cranes of other proportions.

Framing.—This is of pitch pine strongly framed and secured by bolts and wrought iron plates. Rails to carry the crab are fixed on the main beams and the ends are fitted with strong shoes which take the tie rods. The truss brackets bolted to the main beams take two rods, enlarged at the ends to retain the full section where screwed, and provided with deep nuts.

Travelling gear.—The wheels have steel tyres, steel axles and the gear, handles, &c. for propelling the crane with the load suspended.

The Crab is constructed with cast iron side cheeks, mounted on wrought iron girders with steel cross beam and steel travelling wheels. The lifting gear is treble purchase with clutches for easily changing the speeds; the cross traverse gear is double purchase. The shafts are of steel, the pawl is wrought iron and the brake has ample power to sustain or lower the load.

The crane is complete with best tested lifting chain, block with wrought iron sides and swivel hook or loop and platform and handrail as indicated in the engraving.

PRICES OF PORTABLE GOLIATH WITH TIMBER FRAME, Fig. 2160.

Power of crane ..	tons	5	10	15	20	25
Span	feet	30	30	30	30	30
Height	,,	14	14	14	14	14
Price of crane	..	£250	£340	£430	£500	£600
Approximate weight ..	tons	8	12	16	20	28

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE HAND POWER GOLIATHS with wrought iron frames as represented in Fig. 2161 were specially designed for erecting bridges in India, but cranes of many other proportions have been built, some of them with the lifting and cross traversing machinery fixed to the side frames and worked from ground level, whilst in others it has been carried on the main beams, and worked (also from ground level) by hauling ropes.

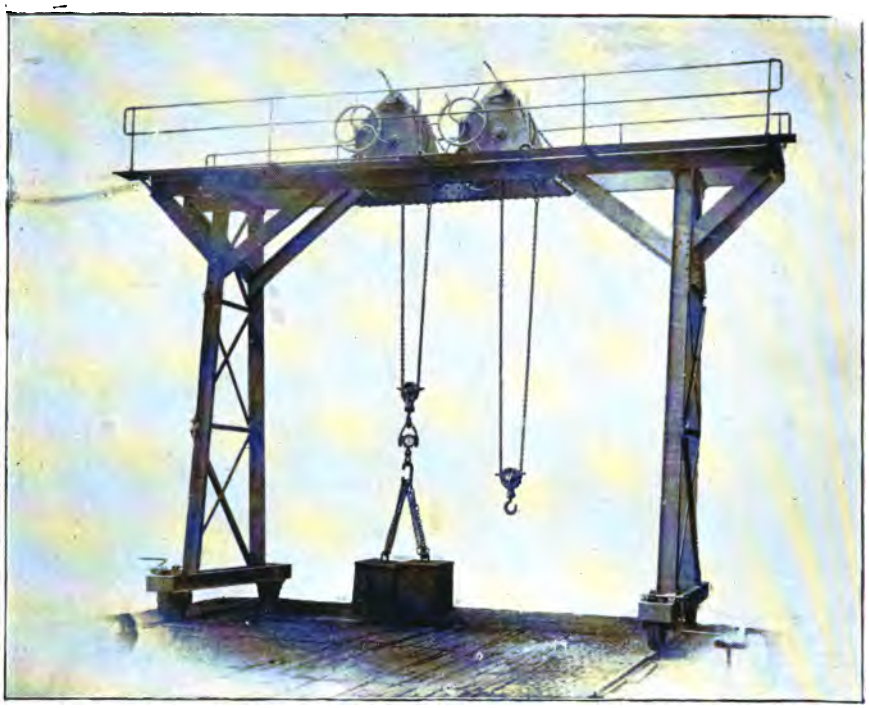


Fig. 2161.

The gantry Fig. 2161 has a span of 22 feet and a height of 21 feet. The undercarriage is provided with travelling gear on each side; the main beams have rails for the cross traverse of the crabs and a platform with handrail is fitted upon both girders.

The travelling crabs, each of 3 tons power, have double purchase gear, brake, pawl wheel, pawl, &c., and are complete with lifting chains and blocks. The first motion shaft is fitted with hand wheels for accurately adjusting the height of lift, as required in erecting.

The approximate price of the crane is .. .. £200.

The weight is about 7 tons and the cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE HAND POWER GOLIATH TO WORK FROM GROUND LEVEL.—The gantry is similar to that shown in Fig. 2161 but the cranes now referred to are used for erecting gun carriages, &c. in one of H.M. Arsenals. It was necessary that the sides should occupy a very limited space, and to effect this, the gear for cross traversing, as well as that for lifting, is carried on the main beams and worked by hauling ropes passing over grooved pulleys. The travelling motion is worked from ground level and within the width of the end carriage.

The power of the crane is 8 tons, the span of the gantry is 35 feet and the height 20 feet.

The price of the crane is about .. .. £325.

A crane of 6 tons power, similar in general design to that last described, also for erecting gun carriages, travels on a gauge of 13 feet and has a clear span of 12 feet, the height being 18 feet from rails to the underside of the main beams.

The price of the crane without travelling motion is .. .. £295.

The gear for travelling, subsequently added, cost .. .. £25.

WELLINGTON TRAVELLERS.—Cranes of the "Goliath" type, whether worked by steam. electric or manual power, are sometimes called "Wellington travellers."

FIXED GOLIATH CRANES.—The usual construction is similar to that shown respectively in Figs. 2160 and 2161, excepting that the vertical members are supported on strong sleepers instead of on a travelling undercarriage.

The machinery may be arranged as shown in either of the engravings but if more convenient, the gear for the lifting and cross traversing motions is fixed to the vertical members, or it may be carried on the main beams and worked by hauling chains or ropes, from ground level. The difference in cost is comparatively slight, whichever system is adopted.

PRICES OF FIXED GOLIATH CRANES.

Power of crane ..	tons	5	10	15	20	25
Span	feet	30	30	30	30	30
Height	,,	14	14	14	14	14
Price with timber frame ..		£220	£310	£400	£455	£550
Ditto wrought iron frame		£250	£340	£435	£510	£627

MACHINERY AND IRONWORK FOR HAND POWER GOLIATHS.—This comprises the whole of the gear, shafting, wheels, axles, bearings, &c., best tested crane chain, block and swivel hook, and the bolts, nuts, plates and other ironwork ready for fixing. Drawings showing the leading dimensions of woodwork, and the construction advised, will be supplied if desired.

PRICES OF MACHINERY AND IRONWORK FOR GOLIATHS.

Power of crane ..	tons	5	10	15	20	25
Span	feet	30	30	30	30	30
Height	,,	14	14	14	14	14
Price for portable goliath ..		£165	£225	£287	£335	£400
Ditto fixed do. ..		£150	£210	£267	£310	£370

FLOATING CRANES need to be considered with special reference to the work for which they are required, but the following engravings and descriptions, indicating the purposes for which each type of crane has been advantageously used, will serve as a basis for determining which system shall be adopted under conditions similar to, or differing from those mentioned.

As will be seen on reference to the engravings, Fig. 2162 represents a crane which rotates around the central pivot, whilst the system represented by Fig. 2166 utilises the rotation of the pontoon for manœuvering and rotating it by warping.

The principles of working are therefore totally different, but the results obtained have been equally good for the purpose for which each type respectively was designed.

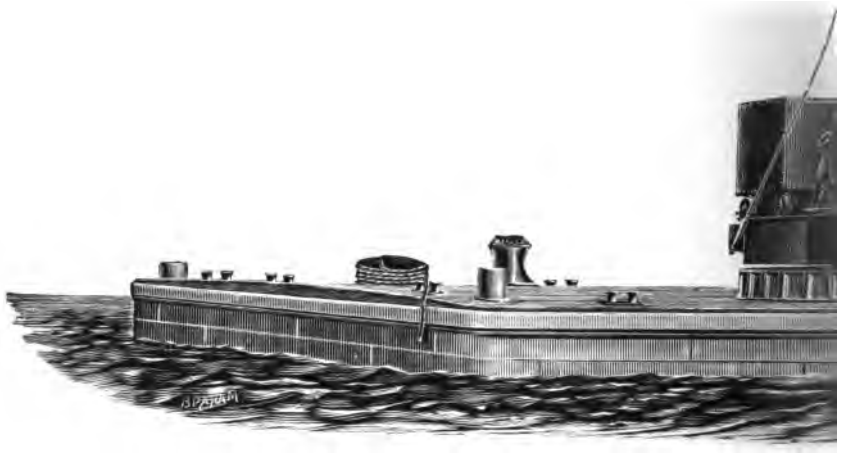
FLOATING CRANES WITH CENTRAL ROTATION.—Fig. 2162 illustrates a 20 tons crane but the same construction is adopted for all powers up to about 100 tons and represents the type largely used in naval and mercantile docks where the first cost is of small importance compared with complete facilities for rapidly putting on board or discharging machinery, guns, stores, &c., whilst working in a space limited to the width of the pontoon.

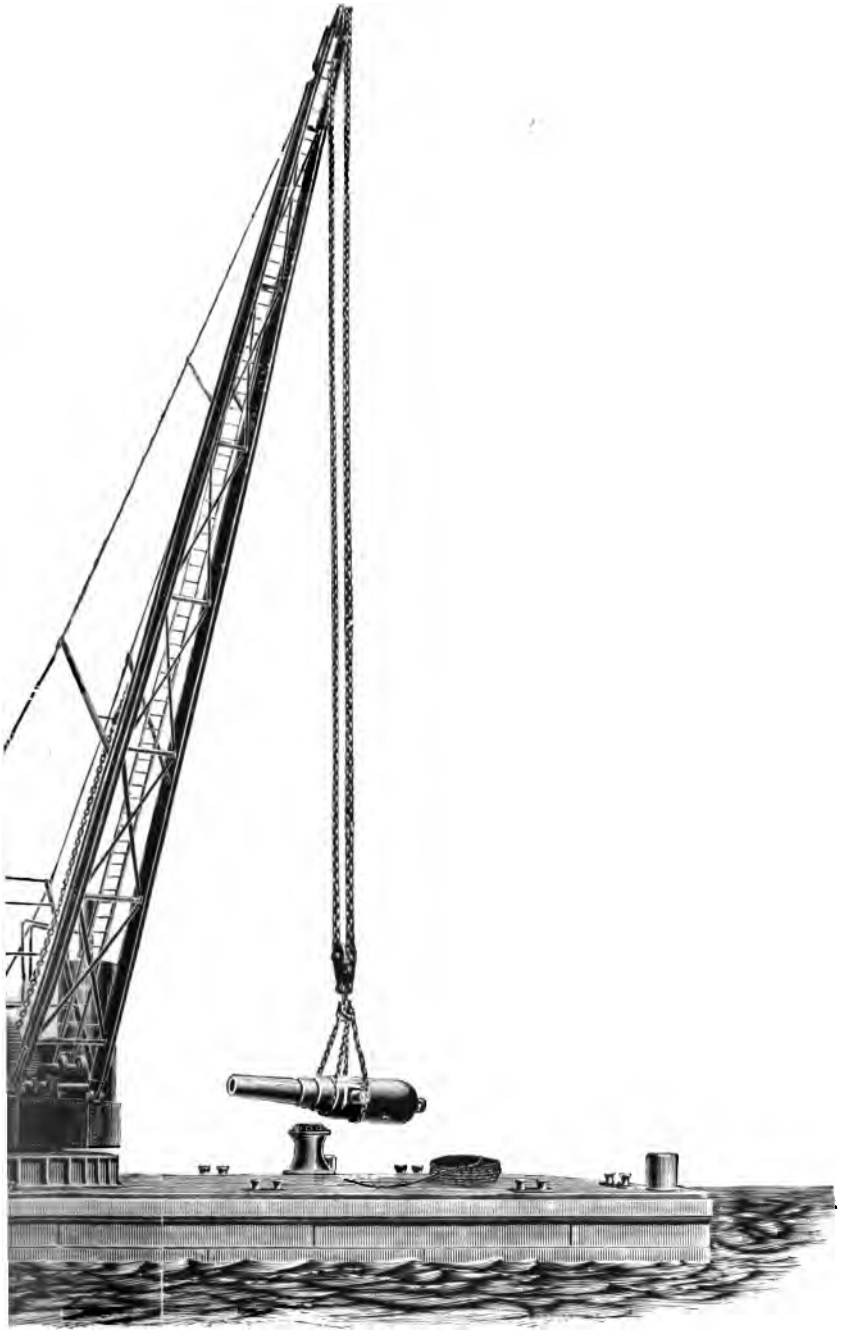
The crane now referred to was required primarily for service in a naval dock, and occasionally in the adjacent mercantile dock, and the water ballast arrangements, mentioned in the following description were necessary for reducing the draft of the pontoon sufficiently for it to pass, at all times, from one dock to the other

The engraving together with the following description appeared in the *Engineer* and is now reproduced, by the courtesy of the Editor of that valuable journal:—

"The increase in the dimensions of sea-going steamers has so far exceeded any estimates which could have been made, even less than a generation ago, that many wharves and docks of comparatively recent construction have a depth of water altogether insufficient for vessels to be berthed near enough to the quay for discharging or loading, and but few of these have been designed with a view to the ultimate use of the powerful cranes which are required for dealing with the heavy and bulky loads which are now of constant recurrence. Where these conditions exist floating cranes seem to offer greater facilities than any other system of lifting machinery, because in most cases they can be used without interfering with the existing equipment or arrangements, and the crane illustrated is one of the types which have been most successfully used.

The crane illustrated by the accompanying engraving is capable of lifting to a load of 20 tons; the crane revolves entirely round, and the point of the jib describes a circle 70ft. in diameter; the height is about 70ft, and it will clear a vessel when moored close alongside the pontoon and standing many feet above water level. The pontoon is 80ft. long and 30ft. beam; the depth is 8ft., the draught being 4ft. 3in., and, as will be seen, the foregoing





62.

dimensions admit of the crane being laid between the vessel and the quay, and reaching to the centre of the largest vessel frequenting the port on the one side where there is deep water, and delivering on the quay on the other side. But as the crane may be moved to any part of the harbour where its services are required, it may be moored on the opposite side, and aid in loading or discharging or in manipulating heavy packages independently of the quay, or in effecting repairs to machinery, removing old and shipping new masts, and so forth Cranes of this type provided with their own propellers will be referred to later on, but as tugs are always available, and there is ample space for manœuvering when the crane under consideration is used, it was deemed undesirable to incur the additional outlay for the propelling engines and accessories. The machinery for working the crane is arranged horizontally in the manner designed by Mr. C. J. Appleby, M. Inst. C.E., many years ago, this being compact and very accessible, and giving a better distribution of strains than any other construction. The necessary stability is obtained by altering the position of the balance-box, and by admitting water ballast under some circumstances which will be referred to later on. By using one or both of these means, the pontoon is always on an even keel, whatever may be the position of the crane and load. The balance-box is run in and out by gear driving a long screw, and working in gun-metal nuts; the power is transmitted from the crane engines, and the lever for working this gear is alongside those for working the other motions. The counterweight having been adjusted for loads within given limits, no alteration is needed until this limit has been exceeded, when of course a further adjustment is necessary. The space between the floor and the bottom plates forms a closed tank extending over the whole area of the pontoon, and a valve worked from the deck admits water into this tank for increasing the immersion, and affording a larger margin of stability in rough water. The structure is divided into eleven water-tight compartments, all firmly braced together, and in one of these is a centrifugal pump, driven from the crane engines, for emptying the water ballast tanks when desired. The roller path is formed of a strongly-ribbed casting, which is secured to wrought iron girders extending down to the floors, and it is machine-faced on its upper surface, on which the friction rollers revolve. These rollers are fitted with steel pins, and are fixed below the jib and the balance-box, and all being driven, it is immaterial, so far as the turning motion is concerned, whether the preponderance of weight is on the lifting chain or at the back end. Steam is supplied from the boiler, which revolves with the crane. The engines and gear are of the usual type, and there are three speeds of lifting, or, by altering the reeving of the chains, four speeds. There are two speeds of turning, giving a traverse respectively of about 80ft. and 160ft. per minute at the point of the jib. Capstans, fair leads, &c., are fixed on the deck, and sides are provided with the usual timber rubbing pieces.

The crane was tested in the works of the makers, with the maximum load, and after this had been done and the parts marked, the machinery and pontoon were taken apart for shipment and re erection at destination."

The price of the crane is about . .. . £3500.

FLOATING CRANES WITH COMPOUND SURFACE CONDENSING PROPELLER ENGINES.—The subjoined data relates to cranes of the type Fig. 2162 but of the greater power and more perfect equipment requisite for discharging vessels at anchor in an open roadstead.

In addition to the large crane, the pontoon carries a steam crane of 5 tons power and jib with a radius of about 50 feet and derrick motion. This crane is used for discharging ordinary cargo, and for grab dredging, &c., when not otherwise employed. The large crane lifts guns, engines, boilers and other heavy loads and deposits them on the deck of the pontoon; this is steamed to the wharf where the crane transfers the loads to trucks which convey them to their destinations.

It will be unnecessary to point out the immense value of cranes of this type for re-fitting vessels, in times of peace or war, under conditions which do not admit of such re-fit being accomplished by any other means.

Floating crane of 30 tons power, with jib of about 46 feet radius to describe a complete circle in either direction. The crane is mounted on strong foundations framed with the pontoon; this is built principally of steel and provided with anchors, chains and the usual outfit.

The boiler is of the marine type and the engines are compound with surface condenser. The machinery has ample proportions for propelling the pontoon at a speed of 4 to 5 miles per hour and is complete with all fittings and accessories.

The price of the pontoon with cranes of 30 tons and 5 tons power, and equipped as above described is about .. .. £14500.

A floating crane of 50 tons power with jib of about 53 feet radius and pontoon equipped as last described costs about.. .. .. £16600.

A FLOATING CRANE AND REPAIR SHOP.—Ample space can be found on board the pontoon for the machine tools and appliances requisite for repairs or renewals, urgently required, which could not be carried out locally without a period of detention impossible to entertain.

With a judicious arrangement of hydraulic and electric appliances (some of which are referred to in Sections I. and IV.) it is difficult to define a limit to the work to be done on board one of these pontoons.

The details required as a basis for design and estimate for floating cranes are principally: The power of the crane, the radius of the jib and whether this should be fixed or variable by steam power. If the pontoon is required, the minimum draft admissible when loaded should be given, and such other information as may be necessary with reference to the dimensions of the pontoon, equipment with propeller, engines, &c.

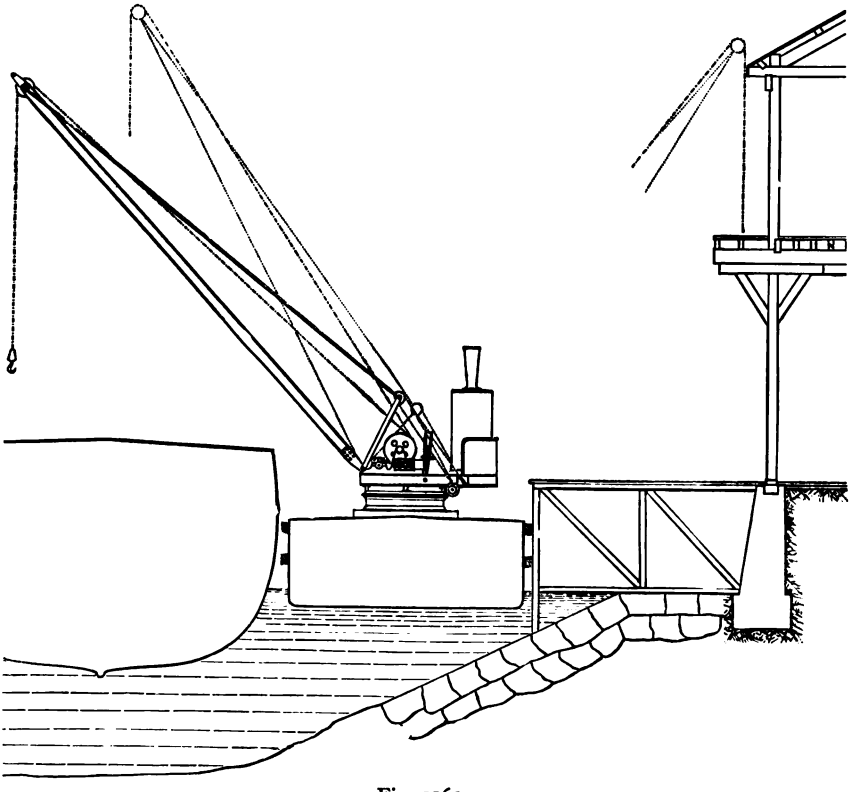


Fig. 2163.

QUICK WORKING FLOATING CRANES.—Although the use of floating cranes may be deprecated if provision can readily be made for the ordinary fixed or portable cranes, they render good service where—as indicated in the diagram, these conditions do not exist.

It will be seen that the depth of water alongside the quay is insufficient for ocean going steamers and the arrangement illustrated was designed by the Writer to deal with the traffic during the construction of the docks and permanent quays. When these were completed, the machinery was moved from the pontoons and now forms part of the equipment of the docks, the staging and sheds being utilised for the coasting and river traffic.

The pontoons—disused mud barges—each carried a rotating steam crane similar to Fig. 2179 with steam derrick motion for adjusting the jib to reach the centre of the hatchway or the upper floor of the goods warehouse, as desired.

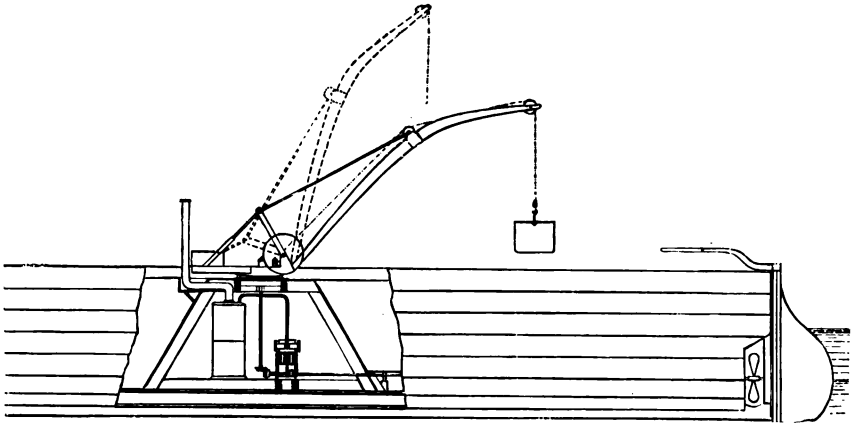


Fig. 2164.

FLOATING CRANE AND COAL OR GOODS STORE.—The diagram, Fig. 2164 indicates an arrangement designed by the writer for use in a Port of call where the quay space is frequently insufficient and where—for various reasons—the owners of vessels prefer to load and discharge in the stream.

The fore and aft compartments provide ample space for stowing, and the rotating crane, which is fixed centrally, has a derrick motion for adjusting the jib to suit vessels varying widely in beam, dimensions of hatchways, &c. Power for working the crane is transmitted from the Propeller engines which are equal to moving the craft at a moderate speed when fully loaded.

The vessel may be built in steel, iron or timber, and sent out complete with the crane and accessories, but in most cases the hull is constructed by purchasers to suit their own requirements, the parts which carry the machinery being made to drawings furnished with the machinery.

Fig. 2165.

FLOATING CRANE FOR GRAB DREDGING AND BLOCK LAYING.—Fig. 2165 illustrates a combination which has rendered excellent service in the construction of the harbour works for which the installation was designed; when these have been completed, it will be retained for service in dredging, for heavy lifts beyond the power of the quick working quay cranes and, later on, for use in contemplated extensions.

The crane at the after end is of 10 tons power and works a grab excavator of 1½ cubic yards capacity. The fixed crane at the forward end is of 30 tons power and the pontoon is provided with a screw propeller in addition to the deck equipment for manœuvering.

The bed for the concrete blocks is dredged by the grab which is worked by the revolving crane and the blocks are laid by the 30 tons crane before sand, shingle &c. can accumulate.

The fixed crane is of 30 tons power and the jib projects 16 feet beyond the end of the pontoon.

The steam driven winch is fixed at deck level, and lifts the 30 tons load by four part flexible steel wire rope; the block sheaves are bushed with gun metal and the cross head has a freely swivelling hook.

The machinery and ironwork for the crane comprise the winch, steel wire rope, jib shoes, head piece with pulleys and shackle, back ties, bolts and other accessories complete ready for erection.

The jib is constructed of timber and this, as well as the pontoon and all wood work, was built by the purchaser from designs furnished in advance of the machinery.

The rotating crane of the type Fig 2180 is of 10 tons power, and is supported on a massive base plate, with turned roller path for making a complete revolution, and secured to timbers below deck level. The revolving superstructure carries the engine, gear, boiler and jib, all of which have the proportions requisite for rapid working and for the maximum duty above named. The post or centre pin around which the crane revolves is hollow, to take a shaft for transmitting power to the propeller or other shaft.

The jib is of wrought iron lattice construction as shown in the engraving; when at an angle of 45° the radius is 24 feet and this can be increased or reduced by the derrick motion to suit the work in hand, thus commanding a large area and saving loss of time in warping.

The grab excavator is of the half tine type (Fig. 2238) of 1½ cubic yards capacity and is complete with gear to open and discharge automatically at varying heights.

The pontoon.—As already indicated, this was constructed by the purchaser in accordance with drawings supplied in advance and was ready to receive the machinery when this was delivered.

The deck equipment (in addition to the machinery already mentioned) consists of a winch at each corner of the pontoon, and fair leads, chains, anchors, &c. for manœuvering it.

The screw propeller is 4 feet 6 inches diameter with stern tube, propeller shaft, gear &c. for driving the propeller by power transmitted by vertical shaft and gear, from the revolving crane engines.

The prices of the machinery and ironwork as enumerated are:—

For the machinery &c. for 30 tons fixed jib crane .. .. .. Weight about 18½ tons.	£570 0 0
For the 10 tons rotating crane complete .. .. Weight about 23½ tons.	£680 0 0
For the 1½ cubic yard half tine grab dredger	£185 0 0
For the deck equipment including propeller, driving gear &c.	£240 0 0
If without propeller, driving gear &c. the price would be about ..	£130 0 0

FORTY TONS NON-ROTATING FLOATING STEAM CRANE.—Fig. 2166 is a photographic reproduction of one of three cranes required for various services in the formation of one of the most important Naval Harbours constructed in this century.

The Cranes were primarily employed in manipulating concrete blocks weighing about 24 tons, to form a breakwater in "piérres perdues" similar to that at Port Said.

Up to about low-water level, the blocks were dropped from "slip barges" and Hopper barges, but for deposit above that level, they were brought in barges (usually five blocks in each barge) and, after being lifted separately by the Crane, were manœvered into position and (for the most part) dropped from the lifting claws to form a pyramidal structure, the apex of which is about 7 feet above normal water level.

A satisfactory photograph could not be obtained of this portion of the work, but the engraving represents another portion of it where the cranes were employed to remove and re-instate the damaged part of an existing breakwater of the usual rectangular form.

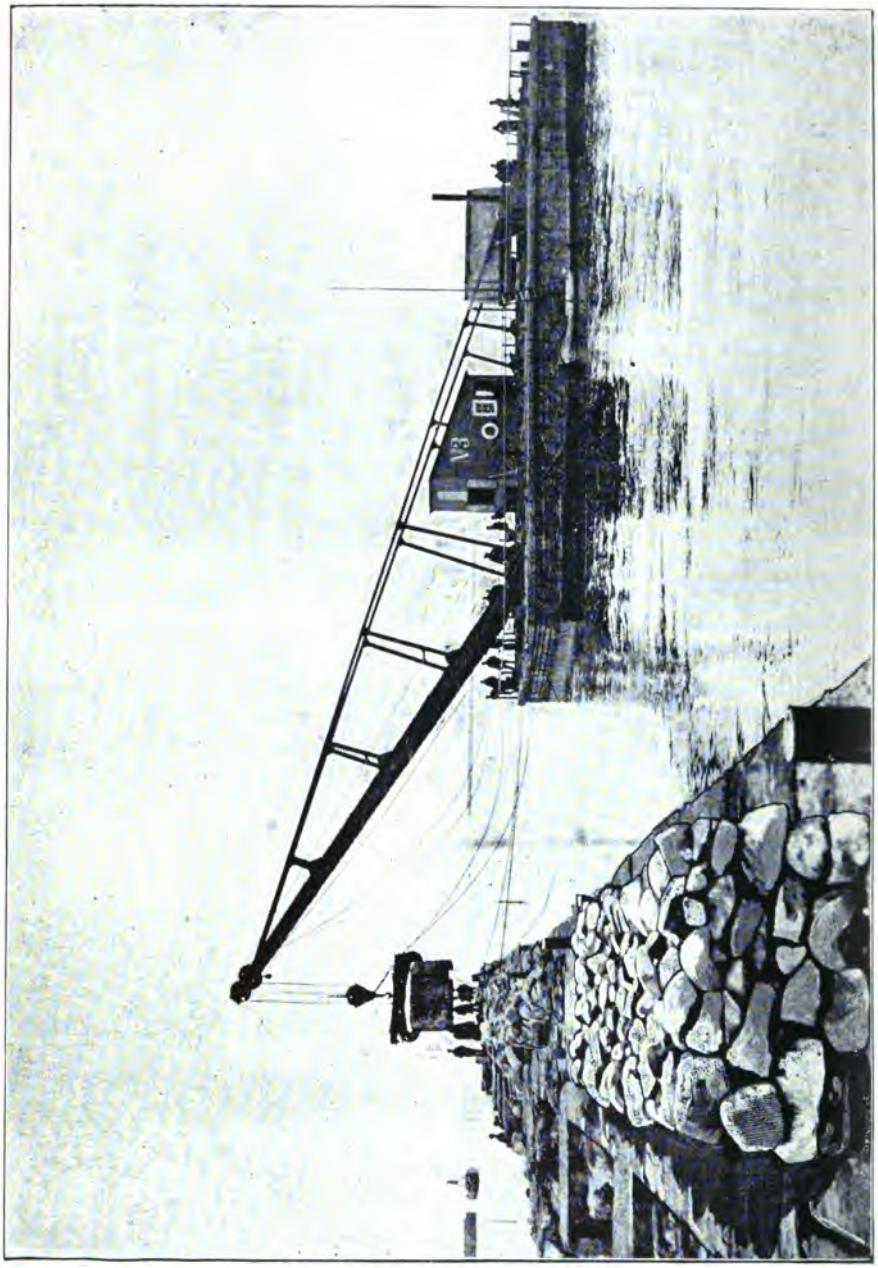


Fig. 2166

The cranes were also employed for many other purposes, amongst which may be mentioned the removal of large boulders and other obstructions met with in dredging, deepening the basins, &c.; picking up blocks which had fallen from the barges; re-arranging blocks which had fallen awkwardly from the slip-barges; setting the blocks which form the coping of the Quay walls, &c.

As the claws must deal with blocks of several sizes and with boulders of unknown shapes and dimensions, several sizes were provided, and each had the simple but efficient appliances described at page 103 for adjusting them to the dimensions of the object to be manipulated.

Having regard to the capital outlay for the large quantity of plant necessary to complete the works in the very short time stipulated, the nature of the work and other considerations, the writer advised that the system of cranes above referred to should be adopted in preference to the much more expensive cranes of the rotating type.

The results have been in every sense satisfactory, and—time being taken into account—it is believed that plant of this power has never before been constructed for such work, at anything like the cost indicated further on.

The pontoons were built of timber from designs furnished by the writer, and the leading dimensions were as follows:—

Length over all	95 feet.
Beam ,, ...	38 ,,
Depth	12 ,,

The jib was of steel, strongly braced and projected 45 feet clear of the pontoon, the height being about 45 feet to admit of depositing blocks at a considerable height above water level. The back ties and struts were specially designed to withstand the exceptional strains incidental to the sudden release of the blocks; provision for these strains was also made in the framing of the pontoon.

Traversing counterweight.—To minimise these strains and to preserve a fairly even keel, concrete counterweight mounted on a strong trolly was traversed back and forth by power transmitted from the hoisting engines. This was set in motion in an inward direction when the block was ready for slipping or laying, and the pontoon quickly righted itself

The trip gear for releasing the block is worked by a light rope carried down to the foot of the jib and works quite freely.

The machinery consists principally of a powerful steam winch with link reversing motions, adjustable strap brake, &c. The barrel is of large diameter, spirally grooved to carry the steel wire lifting rope without overlap; the appliances for traversing the counterweight are driven by the winch engines.

The whole of the machinery is fixed on a frame formed of steel girders to be bolted to the deck of the pontoon, and each set was tested with its maximum load before delivery.

The boiler is of the vertical type and is fixed below where there is ample fuel space.

Capstans, &c.—Four steam driven capstans (fixed one at each corner of the deck) with the necessary fair leads and accessories, serve for manœuvering the pontoon without the aid of a steam tug.

The same result is obtained by two steam winches with capstan ends. These are fixed fore and aft on the pontoon and, under some conditions, are more useful than the capstans. The two steam winches cost about the same as the four capstans.

Propeller engines.—As work at the breakwater was carried on continuously (day and night) for long periods, only one of the pontoons was equipped with compound engines and propellor and the necessary boiler power. The facility thus afforded for moving one of the cranes to any part of the works where its services were required was found to be quite sufficient.

The cost of the machinery for each pontoon, steel wire rope and ironwork exclusive of lifting claws, propeller engines, &c. was.. .. .. £1750.

The total weight was about 62 tons and the cost of packing for shipment and delivery f.o.b. was nearly 5 per cent.

With compound propeller engines, propeller and accessories and boiler of extra dimensions, the cost of the machinery and ironwork as above is about .. .. £2450.

FLOATING CRANE WITH IRON HULL.—A crane similar to that last referred to—also of 40 tons power—with iron hull and steel jib was designed and built by the Writer's firm and sent out in pieces which—as well as the machinery—were carefully marked for re-erection.

The crane was employed, in the first instance, in the construction of extensive quay walls and subsequently for loading and discharging guns, gun carriages, marine engines and boilers, locomotives and heavy machinery and has been in use for about 15 years, without repairs other than those strictly due to wear and tear.

The cost of the crane complete with hull and equipment was about .. .. £3500.

FLOATING STEAM CRANE OF 45 TONS POWER.—Another crane for duties almost identical with those last mentioned (excepting as to power) has recently been built for the same Government, and may be briefly described as follows :—

The pontoon is built of mild steel, in compartments, and is provided with strong timber rubbing pieces. A pair of longitudinal girders carry the machinery and take the stresses transmitted from the jib and back ties. The after compartments are of the dimensions required for water ballast to maintain an almost even keel when the maximum load is suspended from the jib.

The water ballast is supplied by centrifugal pumps driven from the winch engines, and valves are provided whereby the trim of the pontoon is easily controlled.

The deck equipment includes steam winches fore and aft with drums for warping into position, fair leads, bollards, chains, anchors, &c.

The lifting machinery is fixed on the fore and aft girders above referred to and consists of a pair of main engines with link reversing motions ; these, and the lifting and brake gear are of ample power and are carried in wrought iron frames. The winding drum is grooved spirally and coils the flexible steel wire lifting rope without overlap.

The jib, back ties and bracings are constructed of steel. The feet of the jib are carried in strong shoes attached to the main longitudinal girders above referred to ; the back ties and bracings are also connected to them, as shown in Fig. 2160, and are provided with the appliances for accurately adjusting tension.

The factor of safety in the machinery and structure throughout is intended to provide a margin of not less than 6 (six) under the maximum duty for which the crane is designed.

The price of the crane with lifting rope and all the accessories mentioned, is about £4500

The total weight is about 210 tons, but in estimating the cost of freight, an ample margin must be allowed for the excess of measurement over dead weight.

FLOATING SHEARS AND FLOATING DERRICK CRANES.—The conditions under which it is essential that **floating** cranes of these types should be adopted, are so exceptional that little need be said about them, beyond directing attention to the fact that they are always expensive, and that cranes of the type Fig. 2162 or 2166 can be designed to work with at least equal safety, and at far less cost.

FLOATING CRANE DREDGERS.—Although "Dredging and Excavating Machinery" will be treated in some detail in Section V, the crane forms so essential a feature in grab dredging that the subject must also be referred to in this section.

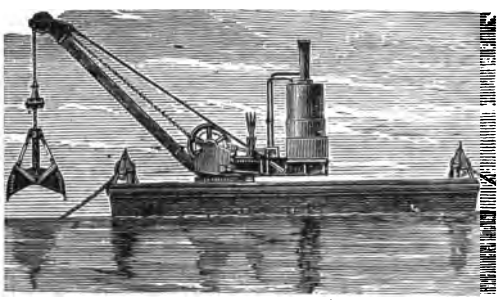


Fig. 2167.

The wide range of operations successfully carried out by this system is referred to later on, but attention may be directed to an erroneous impression —frequently held—that the surface excavated by the grab must necessarily be less level than that left by the ordinary ladder and bucket dredger. Careful observation, however, indicates that this is not so. Inequalities of surface are left by both modes of dredging and are removed by the errosive action of water just as quickly and completely in one case, as in the other.

Amongst the prominent advantages which grab dredging offers may be mentioned the facility for working at great and varying depths, afloat or on shore, and in positions which cannot be reached by any other mechanism, also for excavating or discharging anywhere within the large area covered in the rotation of the jib.

The value of the system has been amply proved under widely differing conditions, such as :—

Dredging for deepening docks, rivers, and other water ways.
Excavating ground, foundations of dock walls, formation of canals, &c.
Clearing the corners, floor, and entrances to docks.
Picking out weeds, rock and other obstructions.
Dredging for gold, sponges, &c.
Sinking cylinders, removing core, weighting, &c.
Depositing concrete under water.
Loading and discharging grain, seeds, sand, coal, coke, ballast and other materials.

The single chain system.—Like some other modern inventions, the grab dredger was rapidly perfected and no important improvements have been made for some years. Perhaps the most noteworthy have been the single chain and the automatic opening crown, illustrated by Figs. 2237 to 2248.

The advantages obtained by these improvements are :—

(*a*) Any crane of the requisite proportions may be used.

(*b*) The operations of lifting, lowering, opening and closing the grab, are controlled by two levers.

(*c*) The opening crown can be adjusted to open the grab at any height desired.

(*d*) The grab can be changed to suit variations in the ground, or it is removed in a few minutes to leave the crane free for any other service.

Pontoons.—A wrought iron or steel barge with crane, grab, capstans, fair leads, anchors, chains, &c., specially arranged for the work, is usually the most satisfactory installation, but the type of barge and position of crane indicated in Fig. 2167 is very generally used. If an existing craft is not available (which, with slight modification, frequently answers every purpose) a pontoon is constructed in timber from designs furnished in advance by the crane builders, leaving the machinery only to be provided.

The information given in the following tables and in those relating to cranes, grabs, &c., will suffice for estimating the approximate cost of floating dredgers and equipments in general use, but they scarcely apply to plant to fulfil exceptional conditions. Amongst these may be mentioned hopper barges with (perhaps) two cranes, separate propeller, steam winches, &c., or pontoons to traverse narrow or shallow water ways which may involve the use of a cylinder (or some other arrangement) on each side, to give the necessary stability when dredging. These, and many other modifications which must remain unnoticed, require special study ; but there is rarely much difficulty in designing the appliances requisite for conditions which have been clearly defined.

Cranes.—The quantity dredged being in direct proportion with the number of operations, obviously the crane should have power and speed for the maximum output. There are several well known advantages in quick working, besides the saving in cost per ton of the stuff dredged.

If the radius referred to in the table, page 39, is insufficient, the cost of a crane of equal power at the radius required, is ascertained by the rule given at page 2. A long reach of jib is sometimes necessary, but for economy in the cost of plant and rapidity in working, it is desirable that the jib should be as short as possible consistent with convenience.

Propeller gear.—If separate propeller engines and boiler are provided, power for working the crane is sometimes transmitted from these engines, but—as a rule—it is better to have separate engines and boiler for each purpose.

Types of grabs.—Good results must evidently depend largely on the grab being suitable for the work to be performed for the time being. Some details will be found at pages 94 to 99 but—as a rule—the type Fig. 2237 is used with advantage for excavating hard or tenacious ground and that similar to Fig. 2242 for mud, silt, grain and similar matter. Many modifications are made, amongst which may be mentioned the full tine grab for lifting stones, boulders and very tenacious soil, and the half tine grab with loose teeth for dredging mud or sand in alternating beds of compact and softer consistency. The teeth are bolted on in a few minutes and render the grab equally efficient in the different kinds of ground.

The opening crown, an enlarged view of which is given in Fig. 2238, can be adjusted to open the grab at any point desired and form a most important feature in the single chain system, the advantages of which have already been mentioned. A quick succession of operations being essential to economical working, these appliances should be used in connection with all grabs worked by single chain.

Work performed.—This necessarily varies greatly with the nature of the materials, the height of lift, the facilities for getting rid of the dredged stuff, &c.

The following table gives approximately the output to be expected, **per hour** from each size of grab the lift not exceeding 30 feet, one man only being required for the duty.

WORKING CAPACITY OF GRABS AND BUCKETS, Figs. 2237 to 2241.

Capacity of grab .. .. cubic yds.	½	¾	¾	1	1½
Dredging mud or sand about .. tons	20	30	45	55	80
Ordinary excavation ,, cubic yds.	15	19	30	40	60
Discharging or loading grain about qrs.	120	140	210	280	420
Do. do. coal or shingle tons	15	20	30	40	60

The respective quantities may, however, be much more, or somewhat less than stated in the table; as a matter of fact, as much as 170 tons—principally mud—has been dredged, per hour, by one set of machinery. With a hopper barge and two sets of machinery, more than double that quantity is dredged.

The working results in loading or discharging vessels carrying **coal, chalk, grain, ballast,** &c., have been equally satisfactory.

Cost of working.—The influences above referred to largely affect the cost per ton of dredging, but the tables afford a basis for estimating working expenses. A very large quantity of dredging has been done at a cost of about one penny per ton, or less for sand, silt, discharging coal, lime, &c.

PRICES, &C. OF MACHINERY FOR FLOATING CRANE DREDGERS.

Capacity of grab .. .. cubic yds.	⅓	½	¾	1	1½
Power of crane .. .. .. tons	3	3	5	7	10
Radius of jib .. .. .. feet	16	17	18	18	18
Price of crane	£270	£300	£370	£450	£560
,, for depth exceeding 30ft., extra per ft.	/-6	7/-	8/-	9/-	10/-
,, Derrick motion to adjust radius ..	£15	£16	£18	£22	£25
,, for felting and lagging boiler ..	£13	£13	£14	£15	£17
,, galvanized iron canopy	£10	£10	£10	£12	£14
,, propeller and gear	£50	£55	£65	£80	£90
,, winches, chains, anchors, &c. ..	£60	£70	£80	£90	£100
,, grab for hard ground, stones, &c. ..	£78	£86	£100	£122	£165
,, ,, mud, hard sand, &c. ..	£66	£73	£86	£107	£145
,, ,, grain, seeds, concrete, &c. ..	£56	£63	£72	£95	£130
,, adjustable opening gear	£9	£10	£12	£15	£20
Approx. consumption of coal pr 10 hrs., cwt.	7	8	10	14	17
,, weight of crane and grab .. tons	10	12	14	18	22
,, measurement ,, ,, cubic ft.	650	700	900	1350	1700

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE STEAM CRANE AND GRAB.—Fig. 2168 illustrates a locomotive steam crane of 5 tons power with a half-tine grab of ¾ cubic yard capacity and adjustable opening gear, but most of the cranes referred to in the following pages may be used for the various purposes mentioned at page 26.

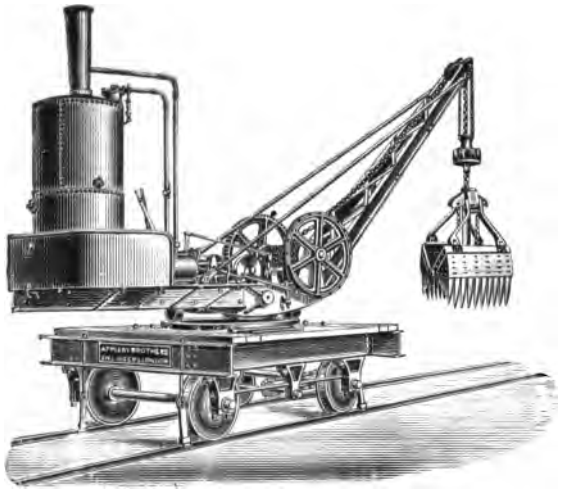


Fig. 2168.

If the grab is required for only temporary use afloat, the crane may be placed on any suitable craft and secured to it by the rail clips, if on wheels as shown in the engraving, or by bolts if the wheels are removed.

By this means much useful work is performed with little or no outlay beyond the mere cost of fuel and drivers' wages; but for continuous work afloat, a well equipped pontoon will be more satisfactory and economical.

The figures in the following table furnish data for estimating the cost of plant of any type or capacity in general use, and further information with reference to cranes and grabs will be found, respectively, at pages 39 to 92 and 93 to 101

Special construction must sometimes be resorted to, but it rarely involves much additional outlay.

The capacity of grabs of all dimensions, when working in different materials, is given (approximately) at pages 27 and 93.

PRICES, &C. OF PORTABLE STEAM CRANES AND GRABS, Fig. 2168.

Capacity of grab	cubic yards	½	½	¾	1	1½
Power of crane	tons	3	3	5	7	10
Radius of jib	feet	16	16	16	16	16
Price of crane	.	£250	£315	£400	£500	£675
,, for depth exceeding 30 feet ..	extra per ft.	6/-	7/-	8/-	9/-	10/-
,, Derrick motion to adjust radius		£15	£15	£18	£22	£25
,, steam travelling motion		£20	£22	£25	£27	£32
,, for felting and lagging boiler		£13	£15	£18	£20	£20
,, galvanized iron canopy		£10	£10	£10	£12	£14
,, rail clips or under girders		£4	£4	£5	£6	£6
,, for grab for hard ground, stones, &c.		£78	£86	£100	£122	£165
,, ,, mud, hard sand, &c.		£66	£73	£86	£107	£145
,, ,, grain, seeds, concrete, &c. ..		£56	£63	£72	£95	£130
,, adjustable opening gear		£9	£10	£12	£15	£20
Coal consumed per 10 hours ..	about cwt.	7	8	10	14	17
Approximate weight of crane and grab ..	tons	10½	13	18	21	32

The cost of packing for shipment and delivery f o b. is about 5 per cent.

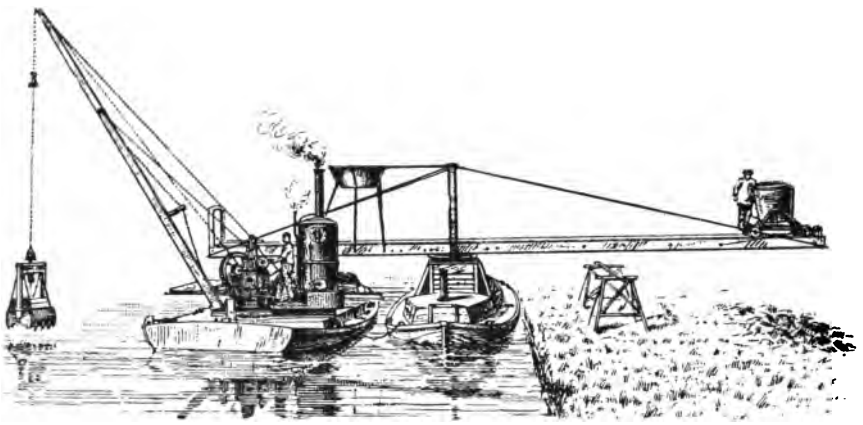


Fig. 2169.

DREDGER SPOIL DEPOSITOR.—Fig. 2169 illustrates a simple and efficient arrangement for economically transferring dredged matter to any moderate distance and discharging it into trucks or on shore for reclamation, forming embankments, &c

The apparatus (Hobrough's patent) is clearly indicated in the engraving, and it will only be necessary to say that the grab discharges over the hopper which conducts the contents into the truck. The platform with rails to carry the truck, is free to tilt to the extent desired so soon as the truck has passed the point of support, and is counterweighted to tilt back when the truck has been discharged. The crane quickly erects the platform, and dismantles it when necessary.

STEAM GANTRY CRANES of the type Fig. 2172 were designed and built by the Author's firm in 1874 and these, as well as many others of all powers from 3 to 35 tons, are now working with the best results.

The diagram Fig. 2170 illustrates how small a quay space is occupied by these cranes, the facilities they afford for complete supervision of the work and for dealing with most kinds of traffic whilst the clear space under the crane, as seen in Figs. 2171 and 2172, admits of free circulation for rolling stock, or other vehicles, without interfering with traffic on the side lines.

Although no system of craneage can equal elevators for economy in discharging grain in bulk, the nearest approach to it is obtained by the use of these cranes working an automatic opening grab bucket shown in Fig. 2237 to 2246 and referred to in detail at pages 93 to 100. For data relative to discharging coal, coke, grain, &c., see page 93.

Revolving Crane.—This is fixed between the main beams, at one end, or centrally as shown respectively in Fig. 2172 and 2173.

Revolving crane with cross traverse.—If the crane must serve **both** sides of the pier or jetty, it is provided with steam travelling motion, or a capstan for hauling, as may be most convenient.

An installation of these cranes of 5 tons power has been in successful operation for many years. Briefly described, the arrangement consists of a pair of girders for each crane fixed, at convenient intervals, on the jetty, which is about 80 feet wide. A line of goods sheds occupies the centre of the jetty, below the crane girders, so that the cranes can pass from one side to the other and work to or from the ship, goods shed, or truck, on either side as desired.

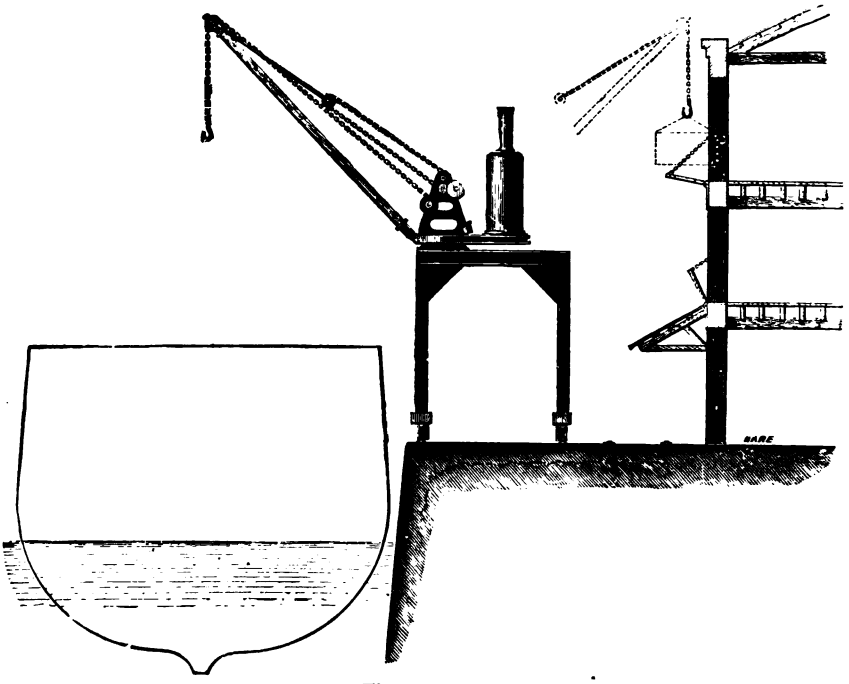


Fig. 2170.

Travelling and capstan motions.—The cranes, Fig. 2172, must be frequently moved—sometimes a considerable distance—and are provided with steam travelling motion and with capstans driven by the crane engine for hauling trucks. The cranes, Fig. 2171, are rarely moved and have not these appliances. Whether the gantry shall be moved by its own steam power, or by hand worked gear, is a mere question of convenience; the latter frequently answers every purpose, and even that is not necessary if the service of a locomotive is at disposal.

Working expenses.—If the work is fairly continuous, the cost of craneage alone for coal, ore or general merchandise, in loads of about 1 ton lifted 20 to 30 feet and turned through half the circle described by the jib, varies from about one farthing to one half-penny per ton.

Including labour on board and on shore the cost—with craneage—usually ranges from 2 to 3½ pence per ton.

Cost of gantry cranes.—The proportions vary so widely that reliable estimates of cost cannot be made without information as to the maximum load to be lifted at a given radius, the span and clear height the gantry must have, the nature of the accessory motions, &c.

The cost of each of the installations referred to is however given, and these may be regarded as generally useful proportions.

The gantry (either fixed or portable) may be constructed, wholly or partially, in timber, but wrought iron is usually to be preferred.

GANTRY CRANES OF 20 TONS POWER.—Fig. 2171 represents two of these cranes on the jetty which forms an important feature in the James Watt Dock, at Greenock, and Mr. Kinipple, M. Inst. C.E., the Engineer in Chief of those admirably arranged docks writes as follows:—

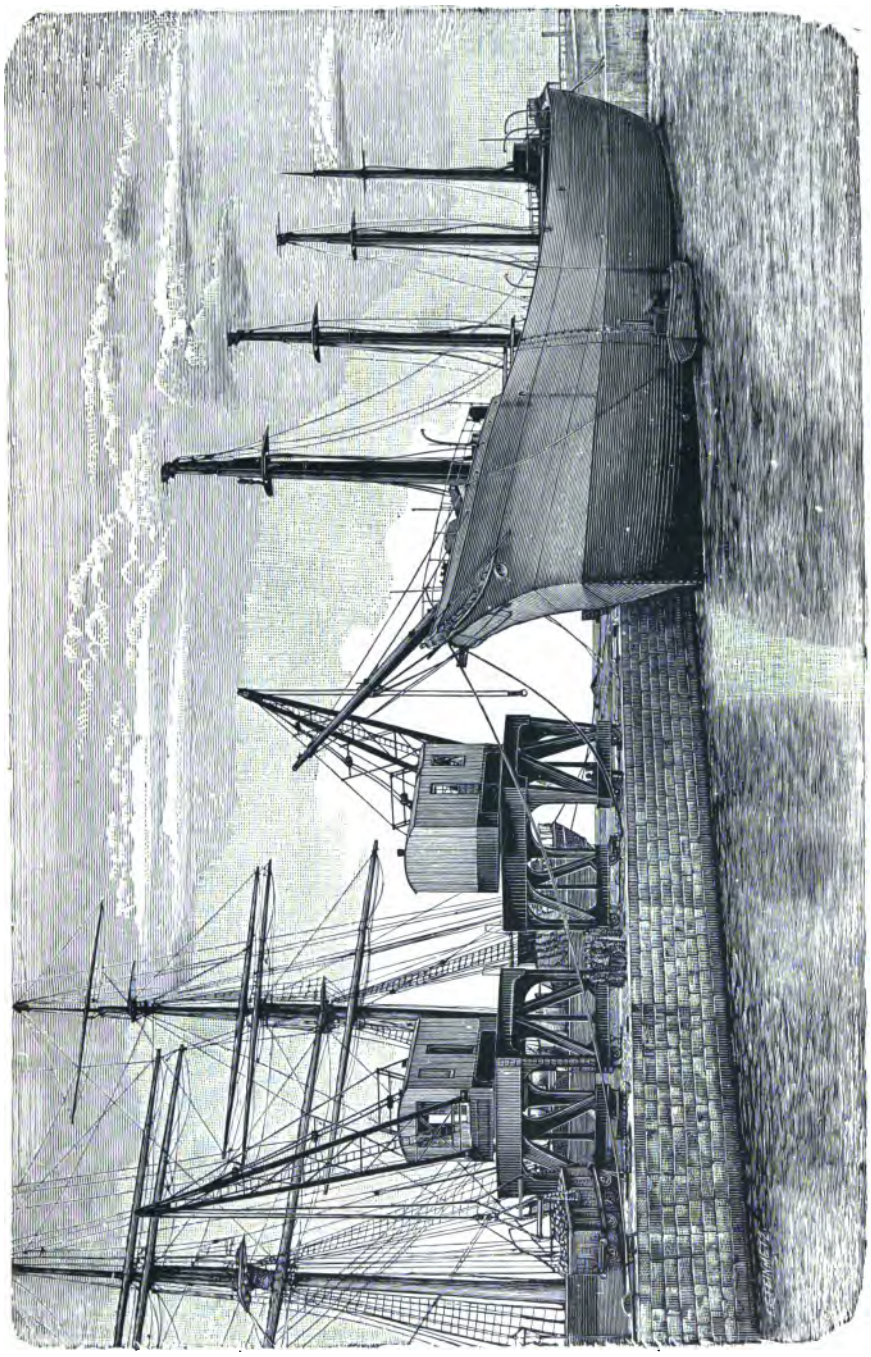


Fig. 2171.

"They (the cranes) have fulfilled all the requirements of my specification, and for smallness of cost, coupled with facility for travelling from one end of the quay to the other without in any way interfering with the work on the quay, I am of opinion that they are of the best design possible for localities where there is not only a large coal trade, but other trades The cranes are used for loading machinery, masting vessels, &c., besides coal. The cranes have done 22 trucks per hour."

The cranes are constructed principally of mild steel, and are complete with appliances for lifting the cradle and truck and for tipping them in any position within a radius of 38 feet, and at any height from water level up to about 70 feet.

As will be seen from the engraving, the gantry spans two lines of railway and the clear height admits of rolling stock and locomotives passing freely beneath it. The height at which the driver is stationed enables him to work without a signal man.

Although the cranes are used for many purposes they were designed more specially to afford the best facilities for shipping coal direct from trucks, which have end openings, and vary in capacity from about 7 to 10 tons, nett load.

Mode of working.—The loaded truck is run on to a cradle built of steel with appliances for holding a truck of any size in position. The crane lifts the cradle and truck, as shown in the engraving, and—when over the hatchway—a tipping chain (attached to the back of the cradle) comes into operation until the truck is at an angle necessary to completely discharge the coal. The lifting and tipping chains coil and uncoil simultaneously, so that the cradle is placed on the rails and the truck removed ready for the next load. There are two cradles for each crane and an operation with No. 2 commences as soon as that with No. 1 has been completed.

Speed of working.—As stated in the extract quoted, 22 trucks per hour having been dealt with, it follows that each operation occupies less than three minutes whatever may be the net weight of coal. A similar plant has recently been built to manipulate trucks carrying 15 tons of coal.

The cost of gantry cranes similar to Fig. 2171 is about .. .. .. £2250.
The approximate weight is 90 tons.

The cost of cradles constructed in steel varies in proportion with the dimensions of the trucks, the attachments necessary, &c., but it will probably be from £70 to £100 each.

For FIXED and PORTABLE COALING CRANES see pages 44 to 46 and pages 52 and 53.

TRAVELLING STEAM GANTRY CRANES OF 5 TONS POWER.—Fig. 2172 illustrates one of the cranes built in 1874 and subsequently, for service at the Middlesborough docks.

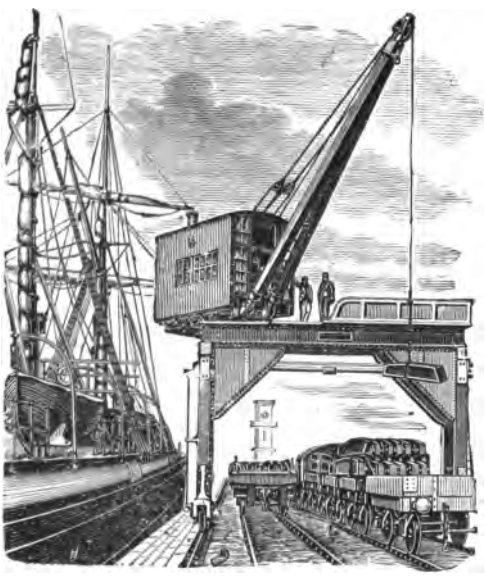


Fig. 2172.

The gantry travels on a track of 23 feet gauge and has a clear height of 17½ feet. The jib is adjusted by the steam Derrick motion to any radius between 14 and 30 feet, but the normal radius of 24 feet commands the whole area between the hatchway and the line of rails outside the gantry frame.

Power for travelling the crane, and for driving capstans on the under-carriage for hauling trucks, is transmitted from the crane engines by shafting and gear. Storage for fuel is provided for at least 24 hours work and mains laid alongside the crane track supply water and gas for working night and day without intermission.

The cranes are used for all purposes, but when landing ore and shipping pig iron—for which the cranes are largely employed—one of the cranes, worked by one man, discharges about 2000 tons of ore or puts 2000 tons of pig iron on board, the vessel being thus ready for going to sea within 24 hours of being berthed.

But this duty is largely exceeded when (for any reason) exceptionally rapid despatch is necessary; this is illustrated by the following incident, which also indicates the advantage of facilities for concentrating crane power.

A steamer entered the dock on the first quarter of flood tide, discharged 5000 tons of hematite ore, and came out of dock on the first quarter of the next tide. This duty was performed by two cranes at the main hatch and one at each hatch fore and aft, or four cranes in all.

These performances confirm the opinion expressed in the paragraph referred to at page 32 that cranes of this construction may be used with advantage for many special, and almost all ordinary kinds of shipping.

The cost of cranes of the abovenamed proportions, with iron gantry and jib is about £725.

A galvanized house with doors, windows, driver's tools, &c. costs about.. .. £30.

For the crane with wrought iron girders to carry it and ready to fix to timber frames, with all ironwork, but without gear, &c. for travelling by steam, the price is about .. £560.

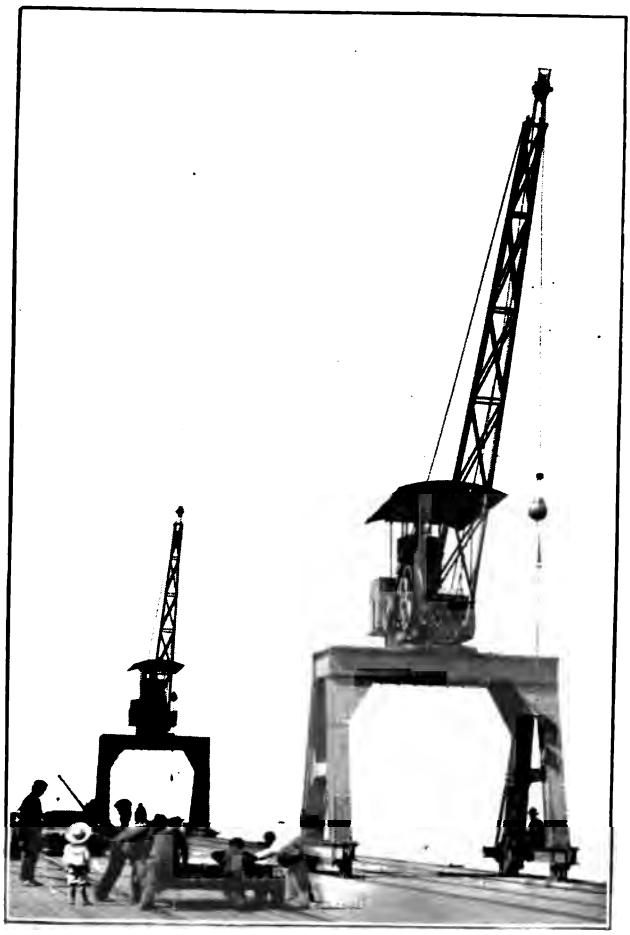


Fig. 2173.

TRAVELLING STEAM GANTRY CRANE OF 3 TONS POWER.—The cranes, Fig. 2173, form part of the equipment of a Continental port which has a traffic in coal, ore, grain and general merchandise, and is visited at rather irregular intervals, by mail and other steamers which require quick despatch; for this purpose two or more cranes are concentrated on one steamer and have her ready for sea in a few hours. The result is in this—as in many other cases—that the port has gained a reputation for prompt despatch, which it did not formerly possess, and the net gain in income is out of all proportion with the outlay for the facilities now provided.

The cranes have steam derrick motions and lift 5 tons when the jib is at the normal radius of 26 feet, or a lighter load at an increased radius.

The gantry is built of mild steel and is provided with steam travelling motion. The span is 15 feet and the clear height 14 feet.

The price of the cranes is about £715 0 0

The weight is about 28 tons.

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

50 TON "FAIRBAIRN" STEAM CRANE.—The crane illustrated, Fig. 2175, generally known as the "Fairbairn" crane, from the fact that it was originally designed by Sir William Fairbairn, in order to obtain great clearance under the jib-head for dealing with bulky packages and for loading or discharging vessels of heavy tonnage, is constructed chiefly of mild steel or wrought iron; the box girder section gives the greatest strength with a minimum of material, and as this girder revolves it always maintains the same relative position to the load, and the continuity of the structure is preserved.

The necessary stability is obtained by the lower portion of the girder working in a circular pit of masonry, or (where a good foundation of masonry cannot be used) in a massive cast-iron cylinder; and cast-iron plate at ground line is bolted to the foundations and bored internally, and at the bottom of the pit or cylinder, there is a cast-iron socket to receive the pivot which is fitted to the foot of the curved girder or jib, hardened steel washers working in oil being interposed to reduce and distribute the friction over a large area. The girder or jib is also fitted with a casting turned on its vertical face, and between this casting and the bored internal ring above referred to, a live ring of rollers is interposed, those directly in line of the greatest strain being of steel; the strains are thus distributed over a large number of friction wheels and a correspondingly large area of the foundation plate or ring.

The arrangement of engines, boiler and gearing does not materially differ from the ordinary steam crane, in addition to those obtained by the chain and blocks; the slewing or turning motions are also fitted with two speeds, and can be manipulated together with the lifting motion, without stopping or reversing the engines. The barrel is grooved spirally to take the whole length of chain or flexible steel wire rope without an overlap, and the barrel shaft is driven from both sides by double gearing to relieve the shaft of tension. Double hand shafts can also be provided, so that the crane can be worked in all motions when steam is down and only a single lift required; the double hand shafts enable a large number of men to be employed without crowding. If it is desired to take steam from a fixed boiler, the steam pipe leads through the pivot to the engines, or the crane may be driven by an electric motor or a pair of hydraulic engines, the pressure being conveyed to them in the same manner as if steam were used. Many hand cranes of this type have been converted to work by steam or hydraulic power in the manner referred to. The condition as to the radius and height of these cranes being always suited to their special requirements, it is somewhat difficult to quote prices, but the following may be taken as an average both as to dimensions and cost of cranes of the types illustrated.

The engraving, Fig. 2176, is a modification of the "Fairbairn" type, the crane being straight from the point above the gearing to the jib-head sheaves, and instead of the solid web plates, the top and bottom members are connected by transverse ties and diagonal bracing as shown. This type is somewhat more economical in material than the solid web plates, shown in Fig. 2175 and the freights is rather less, but being more expensive in construction, the cost is about equal. In cranes of the heaviest kind a double set of chains or ropes are employed.

PRICES OF "FAIRBAIRN" STEAM CRANES, Figs 2175 and 2176.

Power of crane ..	tons	30	40	50	60	80
Radius of jib ..	feet	25	30	35	45	50
Height of jib head ..	feet	35	35	40	50	60
Prices with boiler complete ..		£1100	£1300	£1750	£2300	£3000
Price for iron housing ..		£45	£50	£60	£75	£90

Packing for shipment and delivery f.o.b. usually costs about 5 per cent.

The above prices are exclusive of the cast-iron caisson, sometimes used in peaty or unsound ground, and the cost of these may be estimated at about £12 to £15 per ton, including fitting, facing, and bolts ready for fixing.

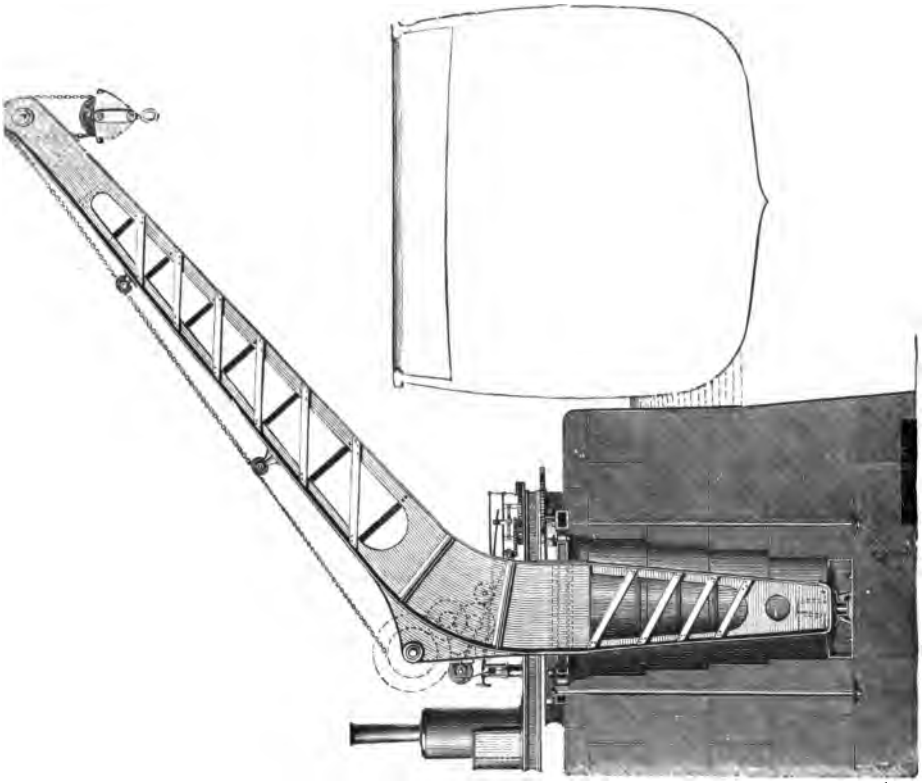


Fig. 2176.

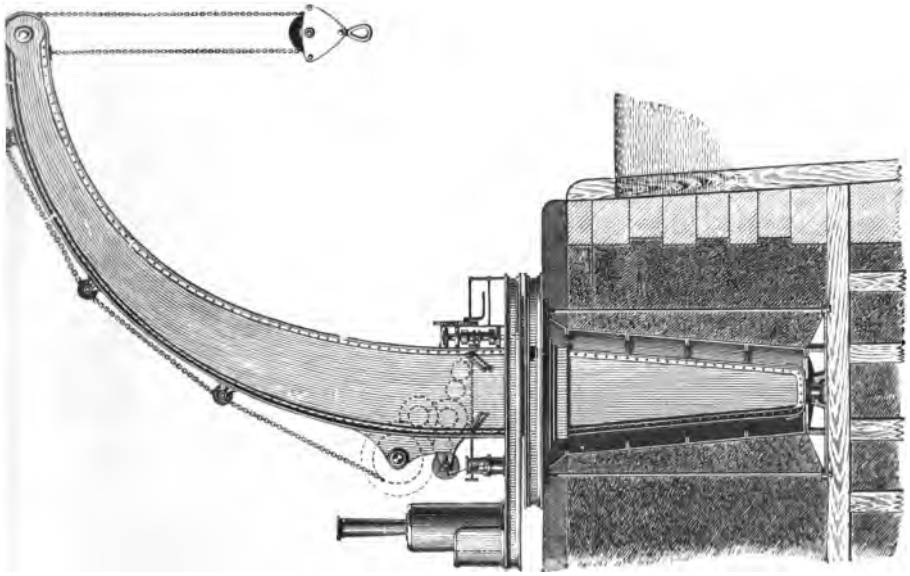


Fig. 2175.

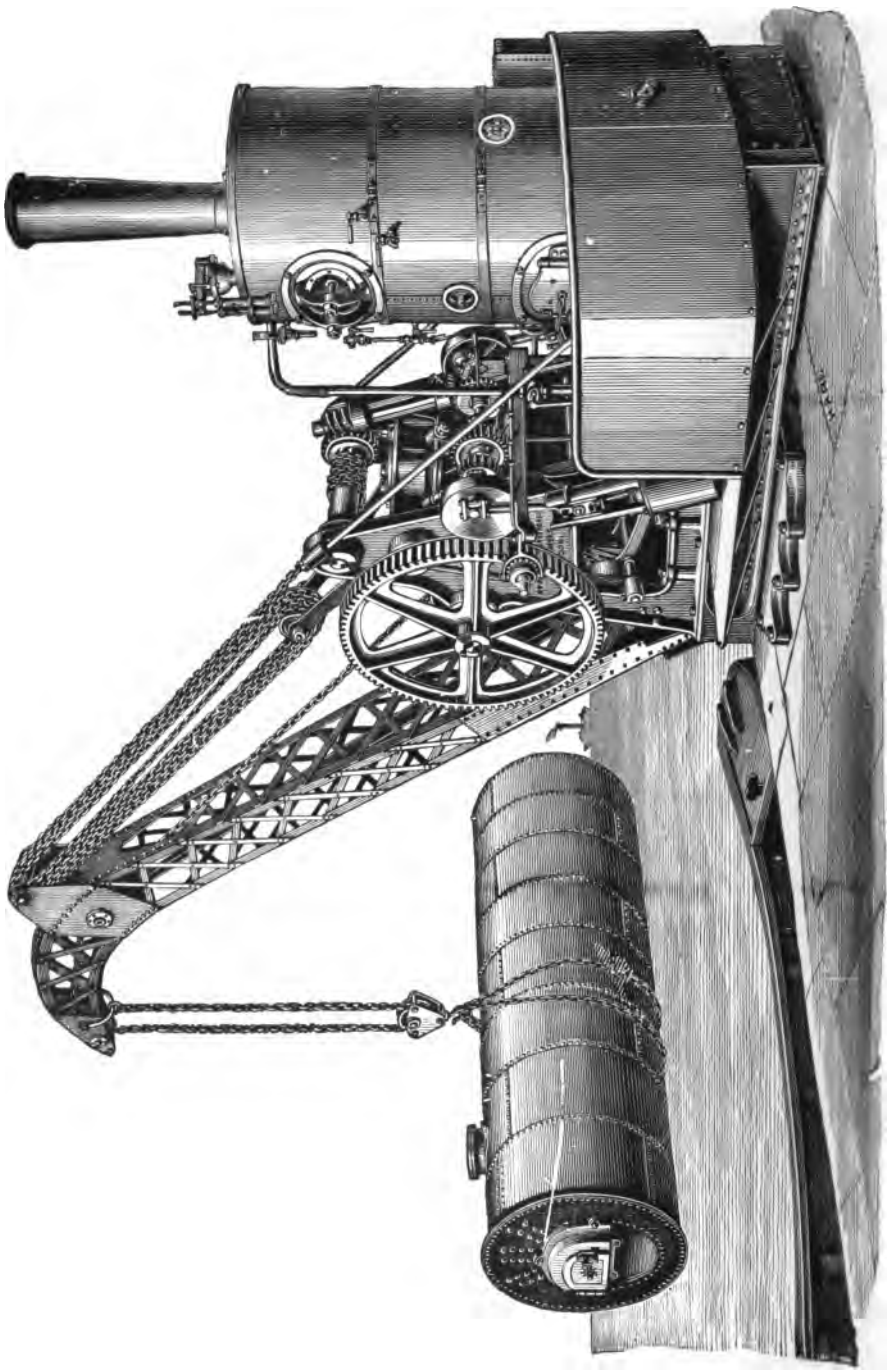


Fig. 4177.

"FAIRBAIRN" CRANES DRIVEN BY ELECTRIC OR HYDRAULIC MOTOR.—The general design is as above described, but the boiler and engines are replaced by a motor, the electric current or water pressure being carried through the central pivot in the same way as when engines are supplied with steam from a separate boiler.

The prices do not vary materially from those of equal power, of the type Fig. 2175.

30 TONS FIXED STEAM CRANES, similar in construction to that illustrated in Fig. 2185, but with massive foundation plate instead of the travelling undercarriage, are built with and without separate engines and appliances for tipping the truck.

The price of a crane of this type of 30 tons power and 30 feet radius, without tipping gear, is about £1700

The price with tipping gear is about £1806

TWENTY-TON FIXED STEAM WHARF CRANE.—The crane, Fig. 2177, is designed for lower powers than 30 tons, the cost of the Fairbairn type being higher, without (in the large majority of instances) any commensurate advantage being obtained.

The two steam cylinders are fixed vertically, and are fitted with case-hardened link reversing motions; the lifting gear is of two powers, the third power being obtained by a block with the chain reefed to the jib-head. The single gear is proportioned to work loads up to 5 tons at quick speed, the double gear of 10 tons at a lower speed, and the maximum load of 20 tons is lifted with the return chain and block. The turning motion has two speeds, so that the operations of lifting and turning are in unison with each other, and it is transmitted from the engine shaft by a set of bevel wheels and double friction cones put into contact by Appleby's improved central pull gear. Motion is thus given to a *pair* of wide friction wheels immediately under the foot of the crane jib, and the thrust due to the load is distributed over a large area of the turned roller path on the foundation plate.

The crane may be fitted with rigid tie bars, but the derrick motion shown is invaluable when a variable radius is required, as, for instance, to reach the centres of vessels of different beam, or to obtain a height necessary for dealing with exceptionally bulky packages. This motion is transmitted from the crank shaft, by a pair of bevel wheels, to a vertical shaft with a worm on its upper end driving a tangent wheel on the end of a chain barrel, the chains being double and in duplicate—when the radius only requires to be varied without the load; in the case of the crane illustrated the load was required to be derricked, which accounts for the multiple chains shewn, whereby an extra cost is involved.

The crane post is of mild steel or hammered scrap iron, turned to receive the superstructure, and fitted and keyed into the massive iron foundation plate. When steam is supplied from a stationery boiler, the post is bored down the centre and fitted with a steam gland at top and a steam pipe connection below the base plate.

The boiler is usually carried on a feed water tank, which is fixed behind the crane, and forms a platform for the attendant as well as a useful counterpoise to the load. The cross tube type is thoroughly effective and generally adopted, but a multitubular boiler will be supplied if preferred. In all cases the boilers are of ample proportion, and are fitted with all the usual mountings and of the most improved kinds, including double safety valve, steam pressure gauge, and fusible plug in the crown of the fire-box. The feed pump is worked from the engine shaft, but a separate donkey pump or an injector will be supplied at an extra cost of about £15. Sufficient best tested short link crane chain is supplied to reach 20 feet below the ground line when the double chain and block are used.

PRICES OF FIXED STEAM CRANES, Fig. 2177.

Power of crane .. .. tons	15	20	25
Radius of jib .. .. feet	20	20	20
Steam cylinders, two .. .. inches	8 × 10	8 × 10	9 × 12
Price of crane with boiler and tank	£880	£1100	£1350
,, derrick motion	£35	£45	£50
,, iron housing	£35	£40	£50
,, boiler lagging	£25	£25	£25
Approximate weight .. .. tons	33	40	50

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

FIXED STEAM WHARF CRANES, of the type Fig. 2178 are (with but slight modification) constructed of all sizes from 3 to 10 tons power. The following description, however, refers to a 10-ton crane with two steam cylinders, fixed in an inclined position outside each side frame. The guides to the pistons are cast to the top cylinder covers, and are truly bored to receive the slide blocks, the wearing surface being very large; the blocks cottered to the steel piston rods receive the lower end of the connecting rods, which are of wrought iron,

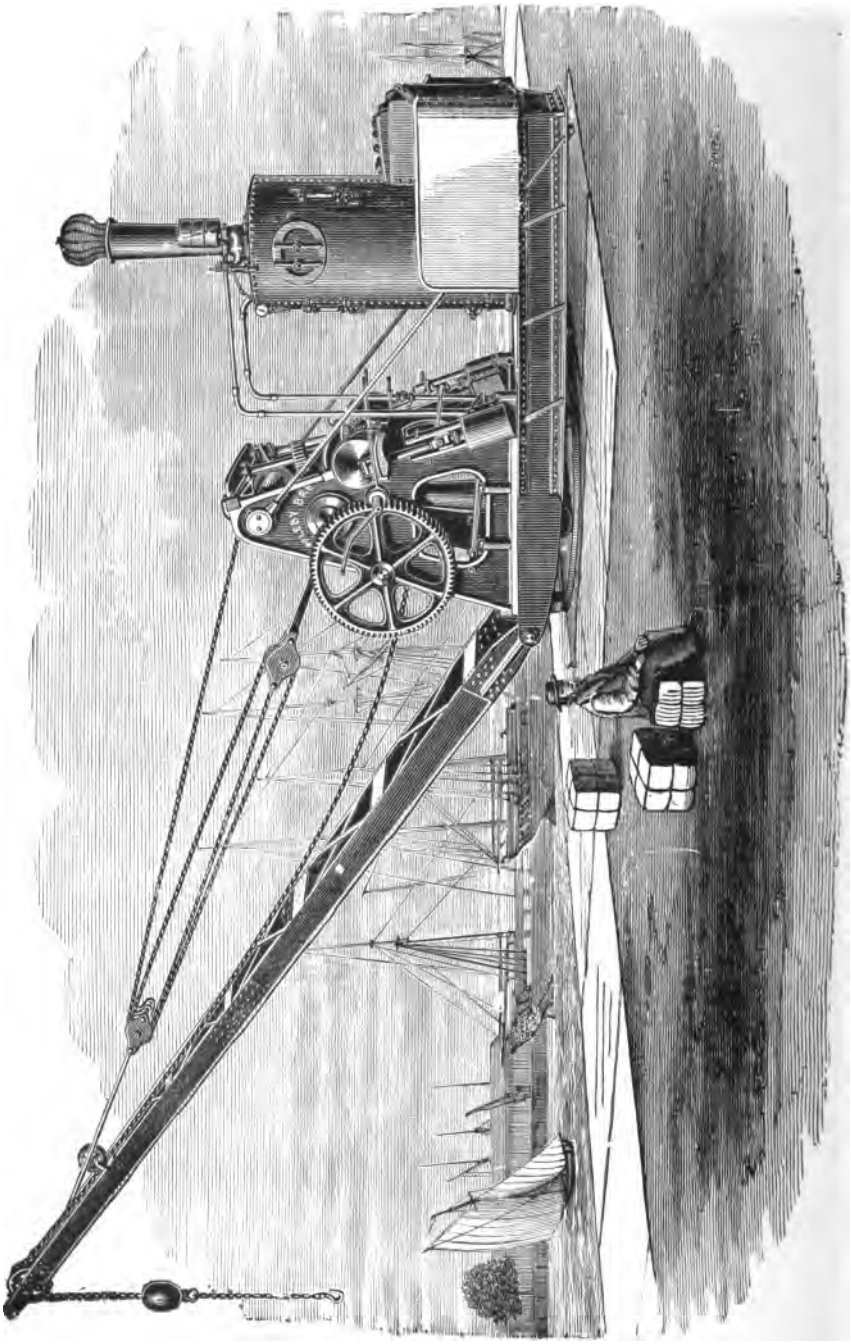


Fig. 2178

fitted with gun-metal steps at slide block end and cross cotter to take up the wear; the crank pin ends are of the marine pattern. The crank shaft is fitted with a pair of turned balanced disc plates, into which the crank-pin ends are rivetted; inside the frames are the eccentric sheaves, with gun-metal straps, and the reversing motion is of the shifting link type; the crank shaft and all the high speed shafts are, as far as possible, fitted with gun-metal bearings, loose caps, and lock nuts; the motions for lifting, turning and altering the radius are driven from the crank shaft. The lifting power is single and double purchase, and the barrel shaft is fitted with a friction strap brake for lowering; for the third power a running block and double chain to the jib-head is used when lifting the maximum load to 10 tons. The turning or slewing motion is transmitted from the intermediate shaft by a set of bevel wheels and double friction cones (the power and speed of slewing being altered simultaneously with the corresponding lifting power), and a vertical shaft and train of bevel gear transmits motion to two large friction wheels which are almost directly in the line of thrust of jib and travel on a turned path on the foundation plate. The friction cones are put into contact by Appleby's central pull gear, and the slewing motion can be worked in either direction whilst lifting or lowering the loads, and without stopping or reversing the engines.

The derrick motion is taken from the engine shaft by a pair of bevel wheels driving an oblique shaft, with a cast steel worm on the top, gearing into a tangent wheel on the chain barrel, around which coils the single chain of the double sheave blocks leading from the top stretcher of the crane framing to the jib-head pin, the worm and tangent gear sustaining the jib in any required position when the first motion wheels are disconnected from the engines.

The engines and gearing are mounted on a pair of cast iron side frames and revolving base; a wrought iron feed-water tank is bolted to this base, forming the foot-plate for the driver and support for the steam boiler which—with the coal in bunkers alongside the boiler—serves to counterweight the load.

The crane post is of steel or wrought iron, and is keyed in a massive foundation plate at ground level; the lower end is carried in a toe plate, and these plates are tied together by wrought iron bolts which pass through the foundations. If steam is supplied from a stationary boiler the post is hollow and is provided with the requisite fittings at bottom and top.

The jib is built of mild steel with lattice bracing and all necessary appliances, including ample means of lubricating the chain or rope sheave.

The boiler is usually of the vertical type with two or more cross tubes, and is complete with fittings, including an injector.

The differences between the crane above described and those of less power are mainly in proportions and radius. Any of them can be made with or without boiler and with a curved jib or such accessories mentioned in the following table, as may be required.

The radius given is that on which the proportions have been calculated; if a greater radius is required, the load must be proportionately reduced or a heavier crane employed; *vide* the rule for this at page 2.

PRICES OF FIXED STEAM WHARF CRANES, Fig. 2178.

Power of crane .. .. .. tons	3	5	7	10	15	20
Radius of jib .. .. .. feet	14	16	18	20	20	20
Steam cylinders (two) .. .. inches	6½ × 10	6½ × 10	7½ × 10	7½ × 10	8 × 10	8 × 10
Price of crane to lift and turn	£400	£455	£510	£685	£940	£1150
,, ,, ,, ,, without boiler	£350	£400	£445	£610	£845	£1040
,, derrick motion	£15	£20	£25	£30	£35	£40
,, curved jib	£15	£20	£25	£28	£45	£60
,, iron house	£20	£20	£23	£25	£30	£40
,, canopy, as Fig. 2194	£10	£11	£12	£14	£16	£18
,, covering boiler	£12	£13	£15	£16	£20	£20
,, injector and fittings	£6	£7	£7	£8	£9	£9
,, tools in lock-up iron box ..	£4	£4	£5	£5	£6	£7
Approximate weight .. .. tons	13	14½	17	21	33	40

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

HORIZONTAL STEAM WHARF CRANES.—The construction indicated in Fig. 2179 and several of the following engravings was designed by the Author to insure:—

Rigidity in the revolving bed which carries the working parts,
Complete facilities for examination and repair; and
To give the driver an unobstructed view of his work.

Patents for the invention have been granted in this and other countries and the large number of these cranes in constant work in all parts of the world, must be regarded as good evidence in favour of this construction.

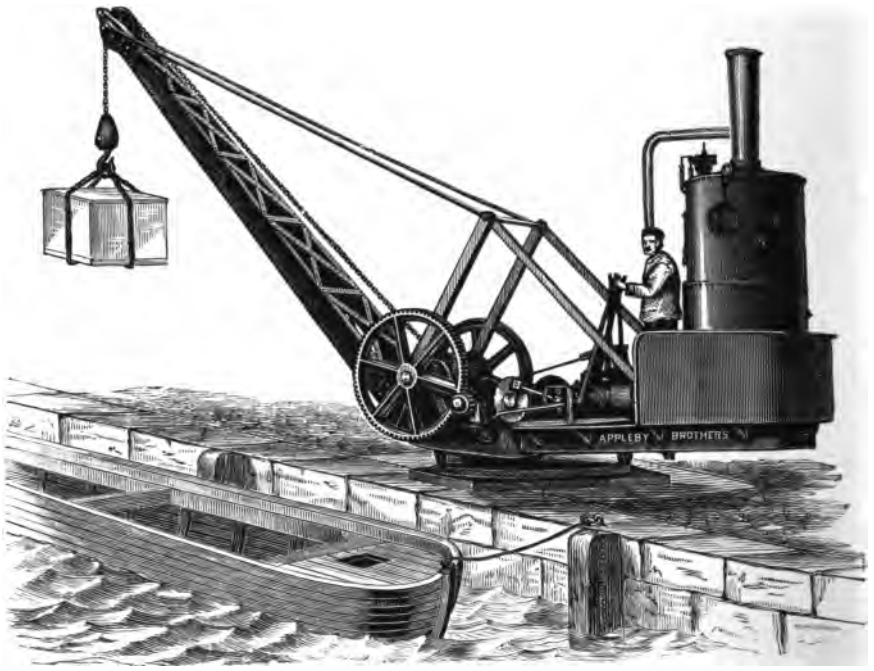


Fig. 2179.

HORIZONTAL FIXED STEAM WHARF CRANES.—Fig. 2179 is engraved from a photograph of a crane of 10 tons power and 25 feet radius and Fig. 2180 from one of 5 tons power and 16 feet radius, but the same type of crane is built of all powers up to about 40 tons and for almost any radius required

The proportions in general use will be found in the tables on the following page. If the radius for a crane of given power must exceed that specified, one of larger power at the normal radius should be used, as indicated at page 2.

For dealing with packages of exceptional dimensions it may be convenient to have a curved jib similar to that shown in Fig. 2185 or 2189; but the necessary clearance below the jib can frequently be obtained by fixing the crane on a masonry, timber or other structure carried a few feet above quay level. If this is insufficient, the crane may be mounted on a gantry in the manner indicated in Fig. 2171 or 2174.

As far as possible every crane is tested before delivery with its own chain or steel wire rope and block, and prices include foundation bolts and plates, best tested crane chain or flexible steel wire rope, screw keys, stoking tools and all requisite fittings.

FIXED STEAM WHARF CRANES UP TO 5 TONS POWER.—The arrangement usually adopted for cranes up to 5 tons power and about 16 feet radius is shown in Fig. 2180.

So few packages exceed three tons in weight that true economy often lies in the direction of providing cranes of this type for loads of the **average** weight, leaving the quite exceptional heavier loads to be dealt with by a powerful hand crane or by the ship's tackle.

PRICES OF HORIZONTAL STEAM CRANES, Figs. 2179 and 2180.

Power of crane .. .. tons	3	5	7	10	15	20
Radius of jib .. .. .. feet	13	14	15	16	18	20
Price with boiler and tank	£270	£340	£435	£560	£700	£995
,, without ,, ,, (as Fig. 2182)	£227	£294	£385	£490	£630	£915
Extra for curved jib	£10	£17	£23	£25	£30	£35
,, derrick motion	£15	£18	£22	£25	£30	£40
Approximate weight .. .. tons	9	12	16	20	25	34

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

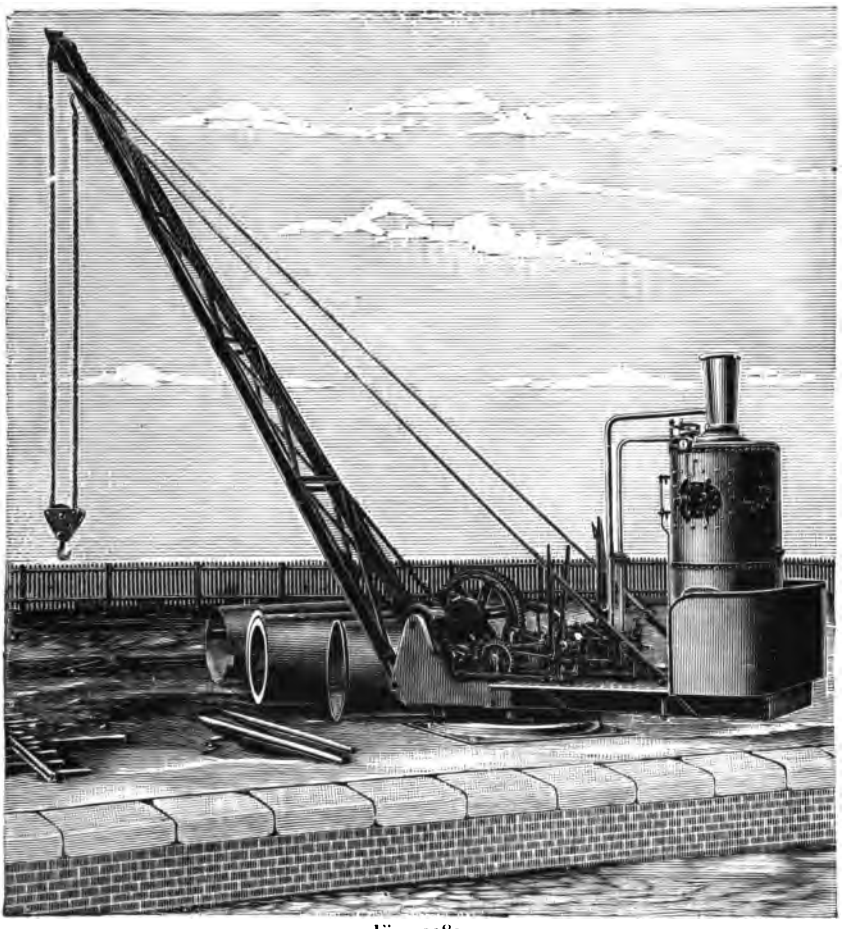


Fig 2180.

These cranes are entirely self-contained and strongly proportioned, and the suggestion with reference to raising the foundation plate, which will be found on the preceding page, applies, and is often advantageously adopted.

The cost of other accessories will be found at page 39.

STEAM WHARF CRANE, Contractor's Pattern.—Fig. 2181. The general arrangement of machinery for this crane is similar to Fig. 2195 and it can be fitted with a steam driven derrick motion, as shown in that engraving.

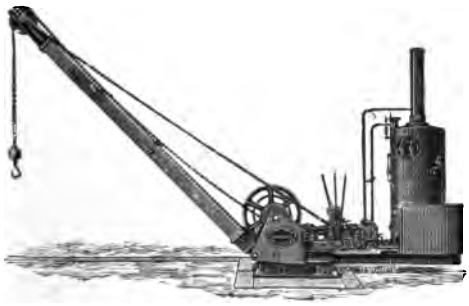


Fig. 2181.

The revolving bed carries the engines and machinery for lifting and rotating, as well as the feed water tank and boiler—if these are required—and is secured by a steel pin or post to a massive base plate prepared for bolting to a jetty or other foundation.

The turned roller path with improved slewing gear around which the crane rotates, is attached to the base plate and the crane is sent out complete with all accessories ready for re-erection and for working.

PRICES OF STEAM WHARF CRANES, Fig. 2181.

Power of crane	tons	1	2	3	5	7	10	12
Radius of jib	feet	12	15	16	16	16	16	16
Price with boiler	..	£155	£207	£260	£330	£405	£480	£540
,, for derrick motion ..	..	£8	£10	£11	£15	£18	£20	£20
,, ,, steel jib	..	£8	£9	£10	£12	£15	£17	£18
,, ,, felting, &c., boiler ..	..	£12	£13	£13	£14	£15	£17	£18
,, ,, iron house	..	£12	£15	£16	£20	£23	£25	£25
,, ,, ,, canopy	..	£8	£8	£9	£10	£12	£13	£15

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

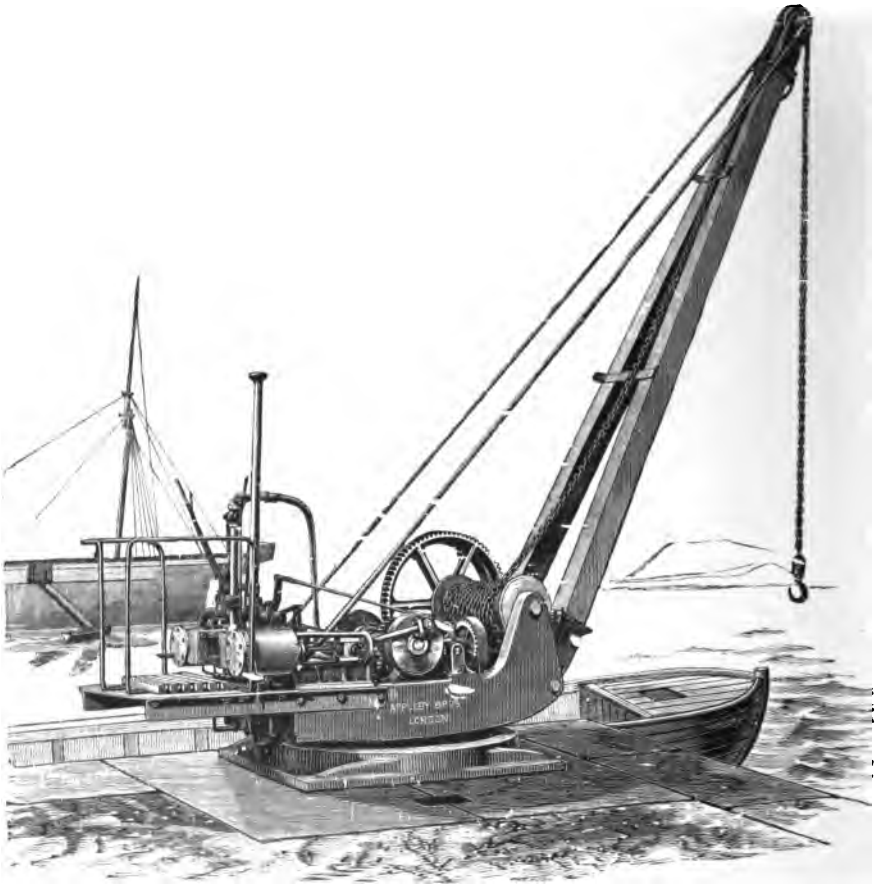


Fig. 2182.

FIXED STEAM WHARF CRANES WITHOUT BOILER.—Steam for the crane Fig. 2182 is supplied from the Factory boilers which, in this case, work at a pressure of about 60 lbs. per square inch, and are at a distance of about 150 yards. If the crane is idle for any length of time some condensed water naturally accumulates in such a length of pipe, but it is easily cleared by opening the cylinder cocks and making a few strokes of the engine before commencing work, or better still, an automatic condensed water ejector can be placed conveniently near the crane.

The steel centre post, around which the crane rotates, is bored, and fitted at the top with a swivelling joint and pipe connection with the engines. The exhaust steam escapes by the vertical pipe shown in the engraving, or is returned through the post and carried to an exhaust tank or elsewhere, as may be convenient.

The bed plate is a massive casting with turned roller path, and the crane is complete with chain, &c., for about 20 feet lift, foundation and bolts.

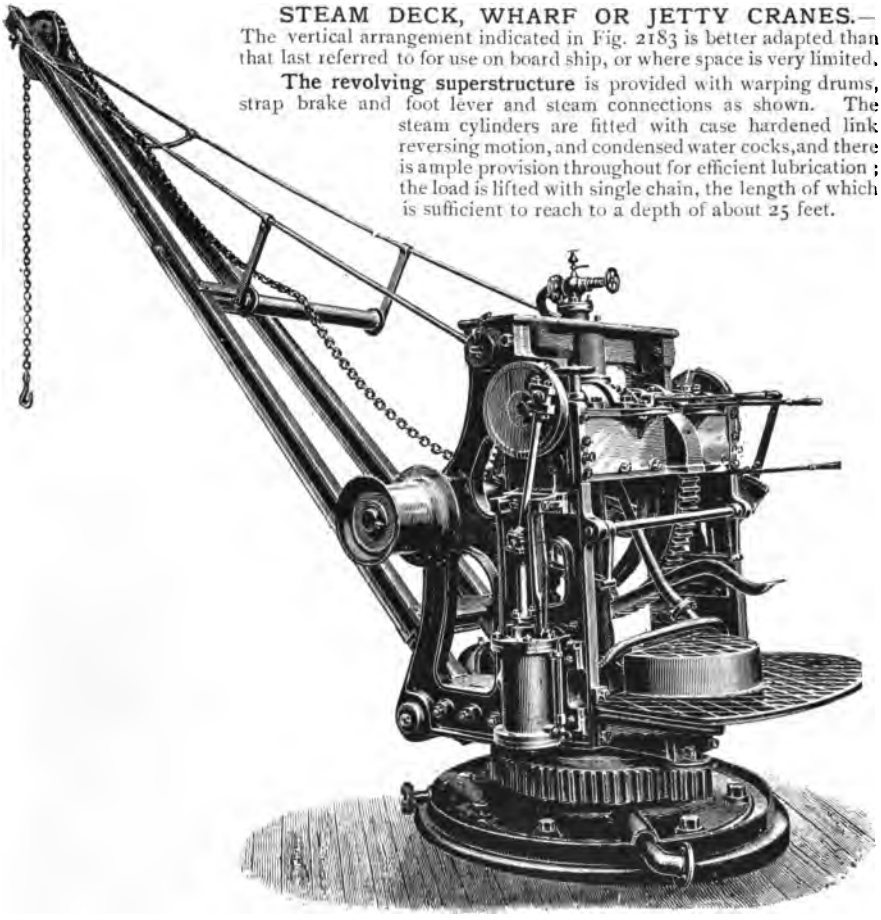
The jib is made of timber as shown, or in steel as in Fig. 2180.

Extra motions and accessories.—The cost of these will be about the same as for the cranes Fig. 2181.

PRICES OF FIXED STEAM WHARF CRANES WITHOUT BOILER, Fig. 2182.

Power of crane ..	..	tons	1	2	3	5	7	10	12
Radius of jib ..	..	feet	12	15	16	16	16	16	16
Price of crane ..	..	..	£130	£167	£217	£280	£345	£408	£460

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.



STEAM DECK, WHARF OR JETTY CRANES.—The vertical arrangement indicated in Fig. 2183 is better adapted than that last referred to for use on board ship, or where space is very limited.

The revolving superstructure is provided with warping drums, strap brake and foot lever and steam connections as shown. The steam cylinders are fitted with case hardened link reversing motion, and condensed water cocks, and there is ample provision throughout for efficient lubrication; the load is lifted with single chain, the length of which is sufficient to reach to a depth of about 25 feet.

Fig. 2183.

The crane post is of wrought iron and usually extends 6 to 8 feet below the foundation plate, for attachment to the lower deck on board ship, or to a toe plate at the base of the foundations of a wharf crane. The steam supply is conveyed to the cylinders through a pipe passing up the post from below the deck level. The exhaust is conducted through an annular space around the steam supply pipe for discharge at a convenient distance from the crane, or through a short pipe to the atmosphere as desired.

The base plate for ship deck cranes is of the form shown in the engraving but is usually of larger dimensions for wharf and jetty cranes.

Cranes with boilers are like Fig. 2183 excepting that they have platforms of the dimensions necessary to carry the boiler, feed water tank, coal bunkers, &c.

PRICES OF STEAM DECK CRANES, Fig. 2183.

Power of crane	tons	1	2	3	4	5	7
Radius of jib	feet	12	12	14	14	16	18
Price of crane, Fig. 2183		£120	£140	£150	£165	£180	£210
,, ,, with boiler		£188	£210	£238	£255	£275	£335
Bed plate for wharf crane extra		£6	£8	£11	£13	£16	£20

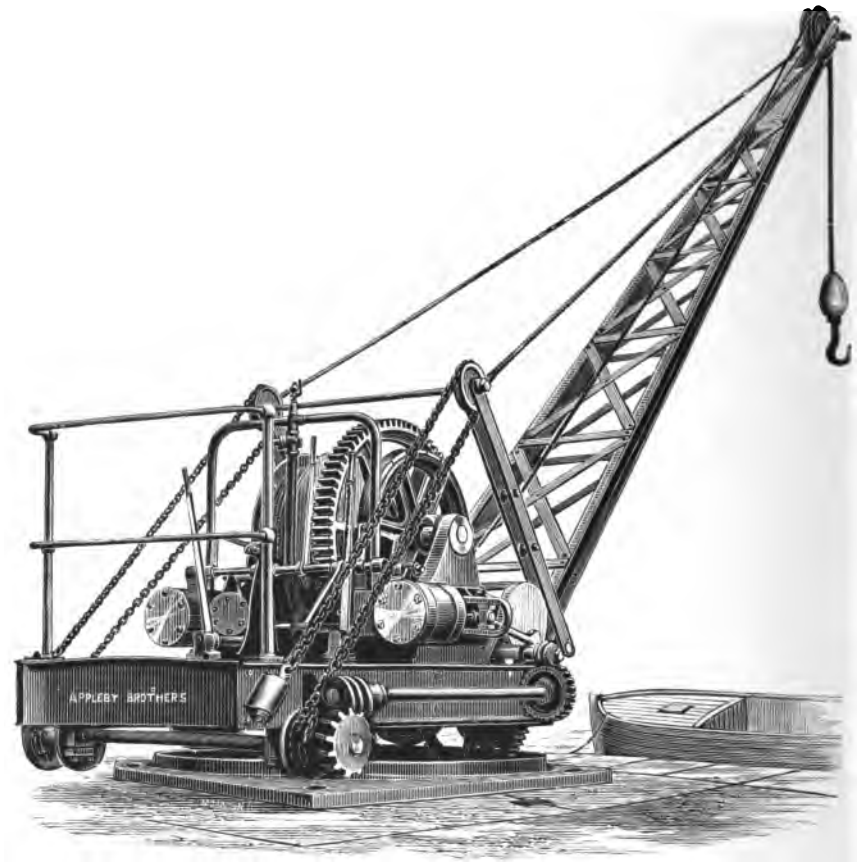


Fig. 2184.

ELECTRIC DECK CRANES.—Hitherto comparatively few of these cranes have been made, but the extended use of electric lighting on board ship will inevitably lead to the general adoption of cranes and winches driven by current supplied from the ship's dynamo.

The cost of an electric crane or winch is rather higher than one of the ordinary type driven by steam, but the advantage in cleanliness, absence of noise and of exhaust steam as well as the higher efficiency of the motor and the convenience in distribution of power, fully justify the small addition to initial outlay—especially on board mail and passenger steamers.

HIGH SPEED FIXED STEAM CRANES of the type Fig. 2184 work loads up to 2 tons at about the same speeds as hydraulic cranes, and have been specially designed for use under conditions which do not admit of the hydraulic system being conveniently or economically employed, as for instance, where only three or four cranes are required, and, occasionally, where extremely low temperatures interfere with the transmission of hydraulic power which may jeopardise the efficient working of the cranes, just at the time when their services are most urgently needed.

Conditions to be fulfilled —The crane selected for illustration forms part of an installation for a large gas-works where the platform area was so limited that the cranes must occupy the smallest space possible. The vessels to be discharged varied in beam and in the distances between hatchways, and moreover, were aground at low water; all these conditions were fulfilled by the adoption of the design shown in Fig. 2184, which, whilst being exceptionally compact affords complete access to all working parts, the derrick motion for adjusting the radius of the jib giving the facilities required for the (more or less) reach, from time to time necessary for plumbing the hatchways.

The revolving superstructure which carries the whole of the machinery is exceptionally strong, and large wearing surfaces are provided for all bearings. Steel is freely used in the wheels and other working parts, and the winding barrel is grooved to coil flexible steel wire rope, or chain, as desired.

The foundation plate has a wide steel roller path, and the saddle at the foot of the jib carries two steel anti-friction rollers working on steel shafts, bored and fitted with lubricators.

The steam supply is obtained from a range of boilers at an average distance, from the cranes, of about 200 feet.

The derrick motion.—The double worm and wheel gear (Appleby's patent) cannot be accidentally set in motion; usually it is not necessary to have a derrick motion for more than one or two cranes if several are employed.

The Cost is largely influenced by the radius of the jib and the maximum working load. The crane illustrated lifts 2 tons at high speed an average height of 40 feet, and has a radius of 25 feet. It easily makes 60 to 70 operations per hour, but the proportions vary considerably, and the prices range from about £360 to £420.

LOCOMOTIVE STEAM CRANE OF 25 TONS POWER.—In addition to the lifting, turning and travelling motions worked by steam power, the crane Fig. 2185 is provided with a pair of engines and appliances for tipping the truck to any angle required for shipping coal in bulk. These smaller engines can also be used for lifting light loads at a quick speed.

The jib is built of steel with a radius of 30 feet and exceptional height and clearance to admit of a truck being lifted above the side of the largest "Atlantic liner."

The machinery consists of a large pair of engines for lifting the maximum load and a smaller pair for tipping or for working all motions when the crane is employed for light loads. The proportions of the gear, shafts, bearings, &c. are ample and the driver—stationed near the foot of the jib—has complete control of all motions. The boiler must (in this case) swing within a radius of about 11 feet and considerably more counterweight is required than would be necessary if more space could be allowed.

The undercarriage is of wrought iron and the travelling wheels are set to a gauge of 11 feet, but this dimension can be varied to any extent desired. The carriage in this case was erected in order to miss the bollards which are fixed at intervals along the quay between the rails as shewn in the engraving.

Fig. 2185.

Work performed.—The crane lifts the cradle and end opening truck which carries about 10 mine tons of coal or a total weight of about 22 tons but, owing to an unavoidably inconvenient arrangement of rails for the loaded and empty trucks the crane can put on board only about 160 tons of coal per hour; this duty would be largely exceeded if the ordinary facilities for rolling stock could be obtained.

The price of the crane with two pairs of engines for the purposes described, with lifting and tipping chains, house, tools and accessories is about .. .. .. £2200.

The weight is about 90 tons.

The cradle, to carry a truck with 10 tons of coal, is built principally of steel and the price complete with sling chains, steel lifting bar with swivel hook, safety attachments for the truck, &c. is about £95,
but these vary in design, weight, &c. and the cost ranges from about .. £70 to £120.

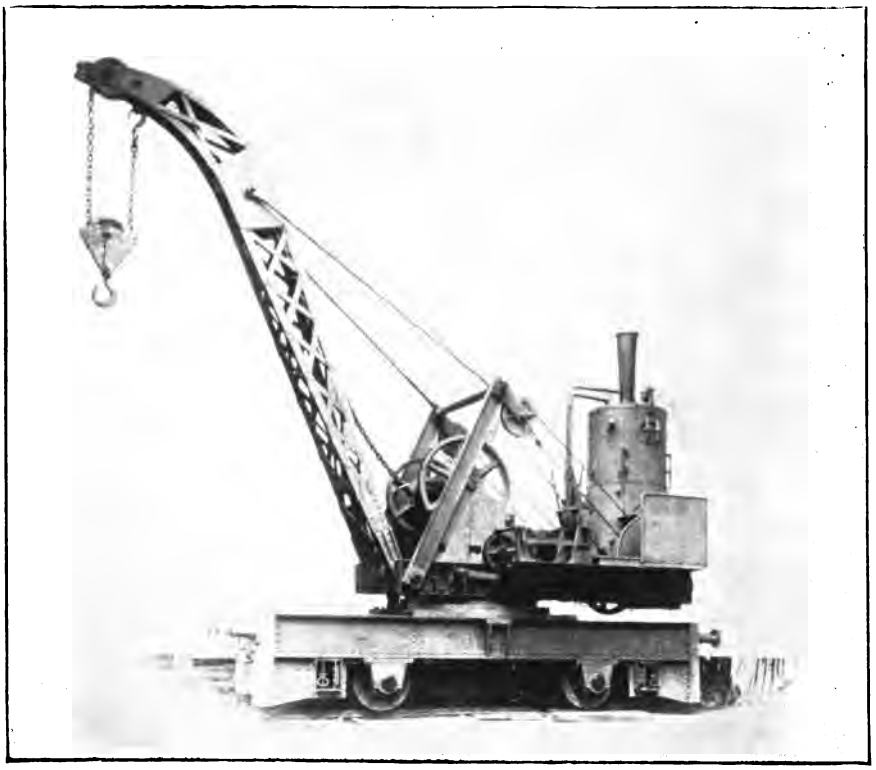


Fig. 2186.

LOCOMOTIVE STEAM CRANE OF 20 TONS POWER.—The photographic reproduction, Fig. 2186, illustrates a crane built for general use in Steel Works where it is employed (principally) in connection with the Siemens-Martin and Bessemer departments, serving large hammers, changing rolls, &c.

Cranes of many other types and power have been made for similar service, but perhaps none of them are quite equal to that now selected for illustration.

The machinery is carried on a massive rotating bed arranged as described at page 39. The gear is of cast steel throughout, the shafts are of mild steel and have bearings of exceptional length, section, &c.

The jib is built of mild steel and curved to give a maximum clearance, and is adjusted by Appleby's double locked derrick motion, to any radius between about 14 and 25 feet, or to the height from time to time required.

The under carriage is constructed of steel girders with massive base plate, hollow steel post, &c., and is fitted with spring buffers, draw gear and accessories, as well as with bumper blocks to suit trollies of varying height for moving ingots, heavy forgings, rolls, &c.

The travelling wheels are of wrought iron with heavy steel tyres; the gauge is 4 feet 8½ inches (1m 335) and, as it was desirable to have only four wheels, provision is made in the axles, journals and sections throughout, for the requisite margins of safety.

Stability.—The crane usually works "free on the rails" as shown in the engraving but, when exceptional loads are manipulated, the road is relieved of strain by drawing out and blocking up the under girders carried in bridles at each end of the carriage, and shown folded within the width of the platform.

The approximate cost of the crane as above described is £1400

The weight is about 48 tons.

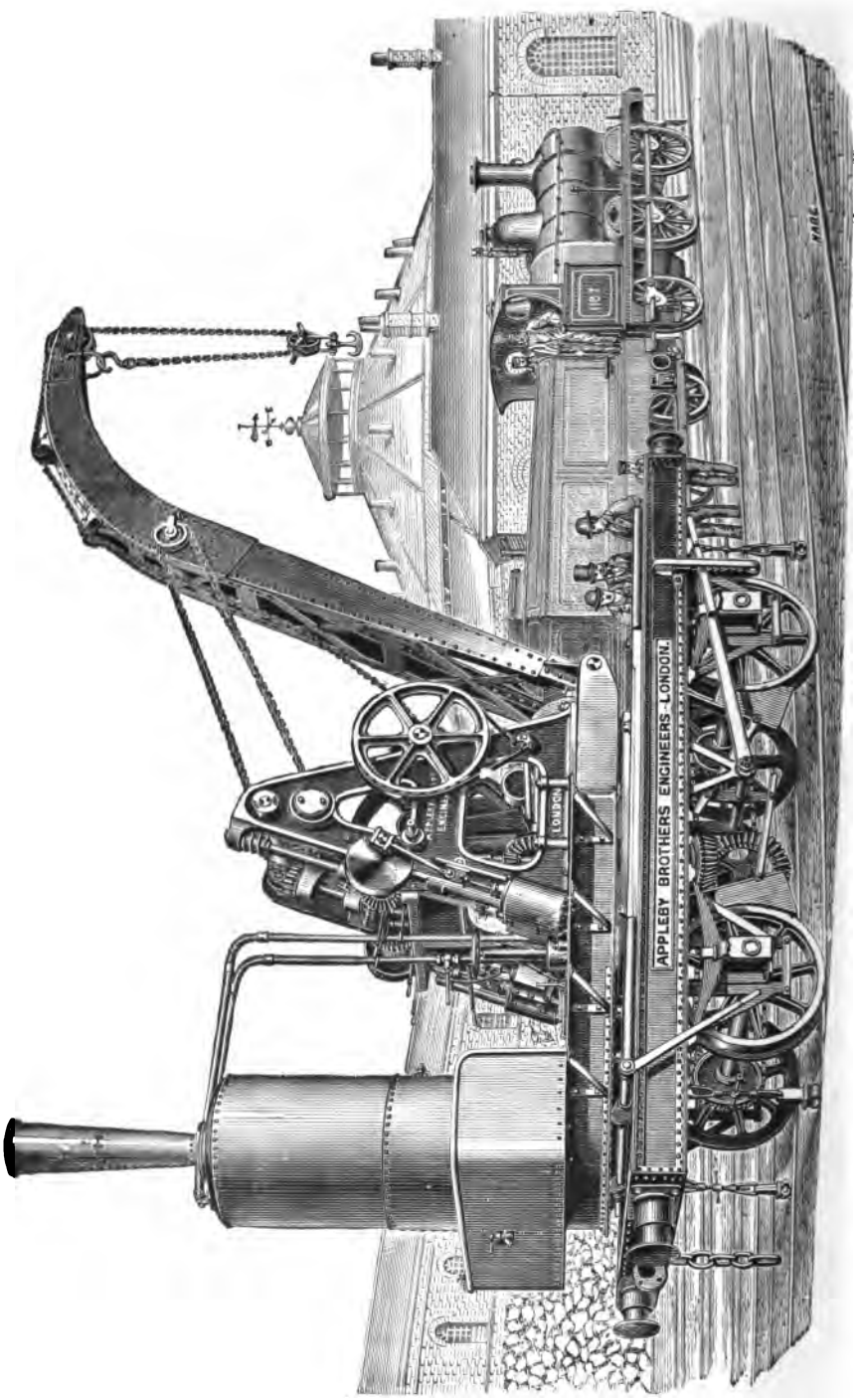


Fig. 2189.

FIXED CRANES of similar construction and of all powers merely require a bed plate of the dimensions requisite for fixing to the foundations, in lieu of the travelling under carriage, shown in the engraving, and the cost is about 10 per cent less than Fig. 2186.

ELECTRIC CRANES, see pages 68 to 71.

PERMANENT WAY LOCOMOTIVE STEAM CRANES OR RAILWAY ACCIDENT CRANES.—Fig. 2189 represents a crane of 5 tons power with undercarriage and all appliances corresponding with the rolling stock with which it works. But these equipments and the proportions are varied to any extent, as will be seen from the following brief reference to construction and to some of the work for which cranes of this type are employed.

The 5 tons crane, selected for illustration, was built many years ago for general use on a main line, and so far as the Writer is aware it was the first crane so employed, but has latterly been so fully engaged in connection with the wagon shops and yard that it has rarely been available for use elsewhere and more powerful cranes have been provided for the general service.

10 and 15 tons cranes of similar construction are provided by another main line. Two are in constant use at the principal Locomotive and Carriage Works, and one at the District Repairing Shops. Any of these cranes are sent out for temporary service in the respective districts.

District service.—Crane power is rarely needed at some stations, and the time when it will be temporarily required can usually be determined. In some such cases it has been found more economical and convenient to send one of the permanent way cranes from the district station when necessary, than to provide hand power cranes where they are very seldom used.

District repairs and renewals.—As is well known to Engineers of Ways and Works almost incredible economy is effected by the "stitch in time" repairs and renewals which are almost invariably made when they can be done with little expense and interference with traffic. Interesting details could be given of work in taking up and relaying permanent way, repairs to bridges and viaducts, loading ballast, setting masonry, &c., the value of which has been fully appreciated by those in charge

Accidents.—The following incident further indicates a kind of service for which permanent way cranes are employed with great advantage.

An accident occurred on one of the main lines above referred to, completely blocking both lines for a considerable distance with serious damage to the permanent way, at a point about midway between the terminus and the district depot. Two cranes were sent from the terminus and one from the depot and got to work about 6 p.m. By 5 o'clock the following morning both lines had been cleared and reinstated, and ordinary traffic resumed.

Construction.—The details at page 53 relating to the superstructure apply equally to that shown in Fig. 2189, and need not be repeated.

The undercarriage is built of wrought iron or mild steel and mounted on four or six wrought iron wheels with steel tyres; the axles are usually of mild steel and the carriage is complete with axle guards, axle boxes, spring buffers, draw hooks, and brake gear of the standard pattern. The buffers are as shown in the engraving or of the central type with draw hooks; the positions of these and the draw chains, &c. are made to correspond with the usual standards for the rolling stock.

In the earlier cranes loops were provided at each end of the undercarriage, through which rails or convenient material were slung to increase the base when lifting the maximum load sideways, and to relieve the permanent way, but the recent practice is to provide girders which are carried in a box at each end of the undercarriage, and drawn out when required.

Appliances are provided for blocking up the carriage and thus prevent the springs from deflecting when heavy loads are lifted.

The boiler is of mild steel and is fixed on the driver's platform which also carries the feed water tank and coal bunkers. The chimney is made to turn back if the headway in over bridges, tunnels, doors, &c., is limited.

The jib is pivotted at the foot for lowering on to the "match" or forward truck when the train is made up, and all appliances are provided for locking the rear end of the boiler platform, which prevents any side movement when travelling.

A pair of shear legs may be fixed under the head of the jib to relieve the crane and road of some of the strain due to an exceptional lift with blocks and tackle; but they are rarely needed and—if they are—can usually be improvised from the materials provided for the use of the break-down gang.

The prices include chains, lifting block, rail clips or under girders, and all accessories ready for work.

PRICES OF PERMANENT WAY STEAM CRANES, Fig. 2189.

Power of crane .. .. .. tons	3	5	7	10	15	20
Radius of jib .. .. .. feet	15	16	16	16	18	18
Price with straight steel jib	£460	£550	£650	£900	£1100	£1450
,, ,, curved ,, ,, ...	£466	£557	£660	£915	£1120	£1480
,, for lagging and felting boiler ..	£13	£14	£15	£16	£17	£18
Approximate weight .. .. tons	16	20	24	35	45	56

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

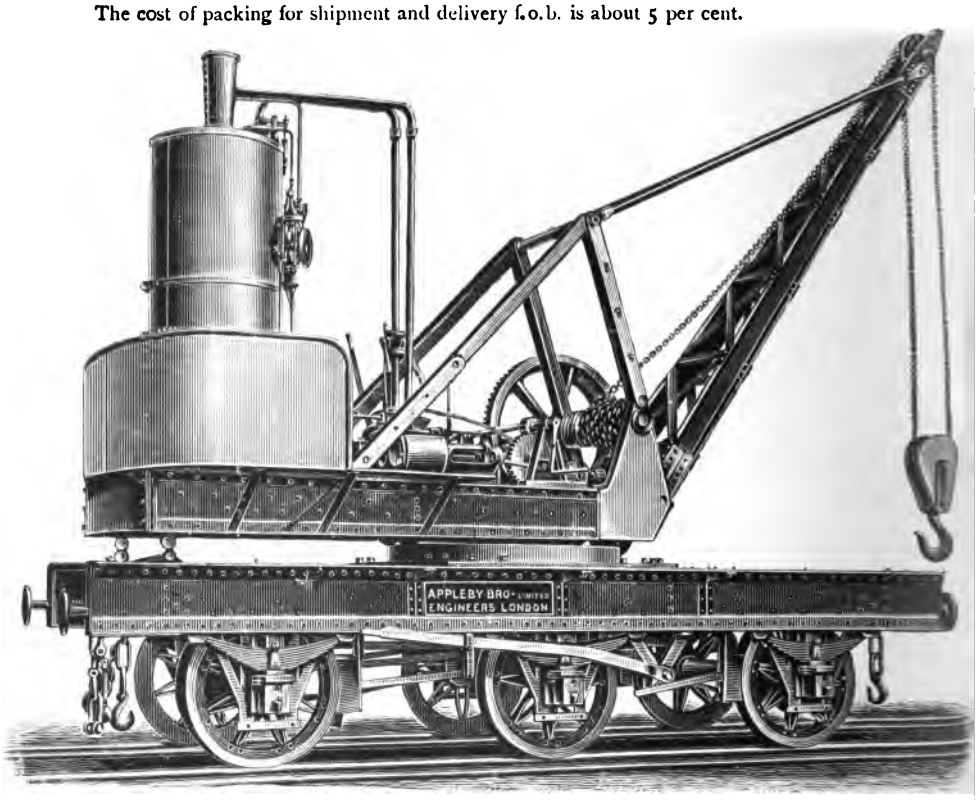


Fig. 2190.

PERMANENT WAY HORIZONTAL STEAM CRANES of the type Fig. 2190, are mounted on massive wrought iron undercarriages of the length required to protect the rear end of the revolving superstructure from impact with other rolling stock, and in many cases, cross girders are provided at each end of the undercarriage, to increase the base and relieve the road of undue strain. The carriage is provided with wrought iron wheels with steel tyres, mild steel axles, axle boxes, springs, buffers, draw hooks and chains, safety chains, locking gear, to secure the crane whilst travelling, and all accessories for running with other rolling stock, and for use wherever crane power is required. Cranes exceeding 10 tons power usually have six wheels, as shown in the annexed engraving and those of lower power have two pairs of wheels as Fig. 2189.

The engines and the motions for turning, varying the radius, and travelling, are carried on a massive cast iron revolving superstructure and these motions may be worked separately or in any combination. The boiler, water tank and coal bunkers are fixed behind the driver's platform which is attached to the revolving bed.

The jibs are made of wrought iron or mild steel, and the curved form is some time necessary for giving the maximum clearance for bulky packages, for reaching over a high-sided truck, &c. The lower ends work on strong pivots, and the chains connecting the jib with the revolving superstructure have the length necessary for lowering it to clear over-bridges, tunnels, &c. ; the funnel also is hinged for this purpose.

The radius of the jib is varied several feet by adjusting the links at the lower end of the back ties If steam power derrick motion is required, it is arranged as shown in Fig. 2186 or Fig. 2195.

Cranes to run with permanent way stock are usually required to lift or lower, turn round, alter radius of jib, travel by steam power, and haul a few trucks if desired, but the cost of the several motions and accessories is given separately, so that the approximate price of the crane can be ascertained without loss of time in correspondence.

Seeing that machinery of this kind usually has to perform exceptionally heavy work, the materials used in the construction are the best of their respective kinds, and the proportions throughout are greatly in excess of those which—theoretically—seem ample.

If no gauge is mentioned, it will be taken to be 4 ft. 8½ in. (1m. 335.)

The number of travelling wheels proper for cranes of this type is frequently discussed and it is singular how often one factor escapes consideration.

This is, that when lifting, although there is no perceptible deflection of the frame of the undercarriage, the road bed always sinks to some extent, in whatever position the suspended load may be.

For this reason the axles and journals of the permanent way cranes referred to are made exceptionally large in section to provide the margin of safety desirable under the above-mentioned varying conditions; the number of wheels need only be in proportion with the weights they have to carry.

PRICES OF PERMANENT WAY HORIZONTAL STEAM CRANES, Fig. 2190.

Power of crane	tons	5	7	10	15	20
Radius of jib	feet	16	16	16	18	18
Dimensions of twin engines ..	inches	6½ × 10	7½ × 10	8½ × 12	9 × 12	9 × 12
Price of crane	..	£410	£510	£700	£1100	£1400
,, steam derrick motion ..	..	£18	£22	£25	£30	£40
,, ,, travelling ,, ..	..	£25	£27	£32	£35	£40
,, curved steel jib ..	..	£20	£23	£25	£30	£35
,, rail clips or under girders ..	..	£5	£5	£6	£7	£10
,, felting and lagging boiler ..	..	£14	£15	£16	£17	£18
,, canopy, as Fig. 2194	..	£10	£10	£12	£14	£15
,, house (iron or timber) ..	..	£20	£23	£25	£25	£28
,, injector and fittings ..	..	£7	£7	£8	£9	£9
,, tool chest and tools ..	..	£4	£5	£5	£5	£5
Approximate weight	tons	18	22	31	42	50

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

Fig 2191

HIGH SPEED PORTABLE STEAM CRANES.—Fig. 2191. The principal difference between this crane and Fig. 2192 is in the form of the jib. Both give the clearance sometimes required for reaching the upper floor of a goods warehouse with a bulky load—such as a sling of sacks or bales—or for work between ship and trucks alongside, and both are designed throughout for high speeds of lifting and slewing.

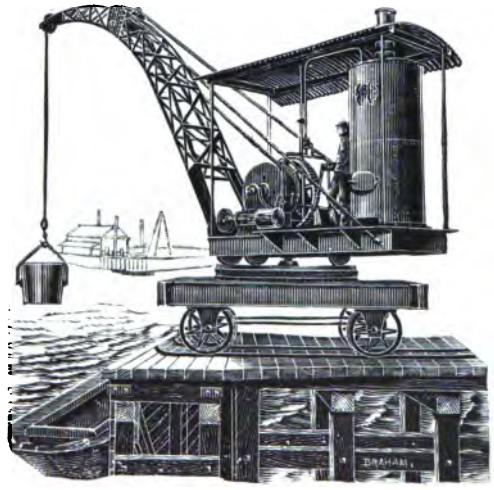


Fig. 2192.

Cranes of these types are made of any proportions or powers, but the radius of the jib has hitherto usually been between 28 feet and 36 feet, and the working load has rarely exceeded 1½ tons. The powers and speeds of working are equal to 2 to 3 complete operations per minute.

The rotating bed carries the machinery, engines, boiler, feed water tank and fuel, as well as the friction rollers which bear on a turned roller path, forming part of the undercarriage. All the small gear is of cast steel, the shafts are of mild steel, and the journals work in hard gun metal bearings with loose caps and lock nuts. The crane is rotated in either direction without reversing the engines, and the levers for all motions including travelling, lowering by brake or by link reversing gear are controlled from the driver's platform.

The undercarriage is of wrought iron and has a massive base plate with a wide roller path and a central boss to carry the crane post or pin. The wheels are of iron with steel tyres; the axles suitable for the gauge required, usually 4 feet 8½ inches, (1m 335) are of mild steel; the bearings for cranes with locomotive gear are lined with gun metal bushes, and draw hooks, &c. are provided when required.

Rail clips, at each corner of the undercarriage, secure it to the rails, or a girder may be fixed at each end to increase the base and take the weight off the rails when the crane is at work.

Capstans.—Many of these cranes have a steam driven capstan, as shown in Fig. 2196, on one or both sides of the undercarriage for hauling loaded or empty trucks.

The crane, Fig. 2191, is of 2 tons power and travels on a gauge of 4 feet 8½ inches. The radius of the jib is about 30 feet 8 inches (9m 85) and the height from rail level to jib head pulley is 29 feet 4 inches (9m 10). The usual height of lift is about 50 feet (15 metres) and the speed of lifting about 100 feet per minute (0m 50 per second); the jib makes a complete revolution in 30 seconds.

Some docks are equipped exclusively with these cranes, the number being increased each year to cope with the increase in traffic.

Electric cranes of the type Fig. 2191.—These cranes are specially adapted to work by electric motor, and its application to some of the existing steam cranes is under consideration.

The price of the crane—of either design—for a working load of 1½ tons with high speeds of lifting and turning, and steel jib of about 30 feet radius is:—

With straight steel jib as Fig. 2193	£450
,, curved ,, as Fig. 2191 or Fig. 2192	£475
Locomotive gear driven from crane engines	£25
Steam driven capstan	each £5
Rail clips or undergirders	per set £5
Galvanized iron canopy, stancheons, &c.	£10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE STEAM CRANES.—Fig. 2193 illustrates a locomotive crane of 10 tons power which was built in 1875 for service in the docks where it is still in constant use.

Similar cranes are in successful operation in all parts of the world, and were adopted by the Commissioners of the International Exhibitions in London, Paris, Vienna, Philadelphia, &c. for general service and—specially—for placing in position and partially erecting the heavy machinery which formed so prominent a feature in each of those exhibitions. In all cases they earned awards of the highest class.

Construction.—The following outline specification, in conjunction with the engraving, will clearly indicate the arrangement of parts:—

All motions, namely, lifting, turning, altering radius, and travelling are taken from a pair of steam engines, placed slightly at an incline, one outside each side frame. The crank pins are fitted into balanced disc plates; each cylinder has link reversing gear, and the piston rods are guided by blocks working in bored guides with large wearing surfaces. The post is of wrought iron turned to fit the revolving bed which carries the side frames. The feed-water tank forms a platform for the vertical boiler, coal bunker and driver, and is placed at such a distance behind the post as to form counterweight for the greater part of the loads.

The lifting power is conveyed from the crank shaft to the chain-barrel by means of spur gear and has two speeds; the load may be lowered by reversing the engines, or by the brake. The turning motion is obtained through double friction clutches, and the crane may be turned in either direction simultaneously with any other operation.

The derrick motion is obtained by a worm and tangent wheel on the chain barrel, the worm locking the jib in any position.

The travelling motion is conveyed from the crank shaft to one or both axles by suitable gear, the shaft transmitting power from the engine, passing down the centre of post.

The undercarriage consists of a wrought iron girder frame which carries a massive central bed casting with turned roller path, as shown in the engraving, but in the smaller size cranes the undercarriage is a complete casting having horns for axles, railclips, &c.

The radius at which the maximum load should be lifted is given in the following table. Lighter loads may be worked at an increased radius but a heavier crane should be used if a greater radius is required for the maximum load than that stated.

The working expenses for these cranes, in London, is about 12/- per day and a 3 tons crane easily deals with 300 tons per day lifted or lowered an average of 30 feet and slewed through about half the circle described by the jib.

Housing for cranes varies greatly according to climatic conditions and individual requirements: in some cases a plain canopy is sufficient; in hot climates it is generally made double with an air space between as shewn in Fig. 2194, and stout canvas curtains made to slide for the protection of the driver, are not unfrequently required. As a rule, especially in this

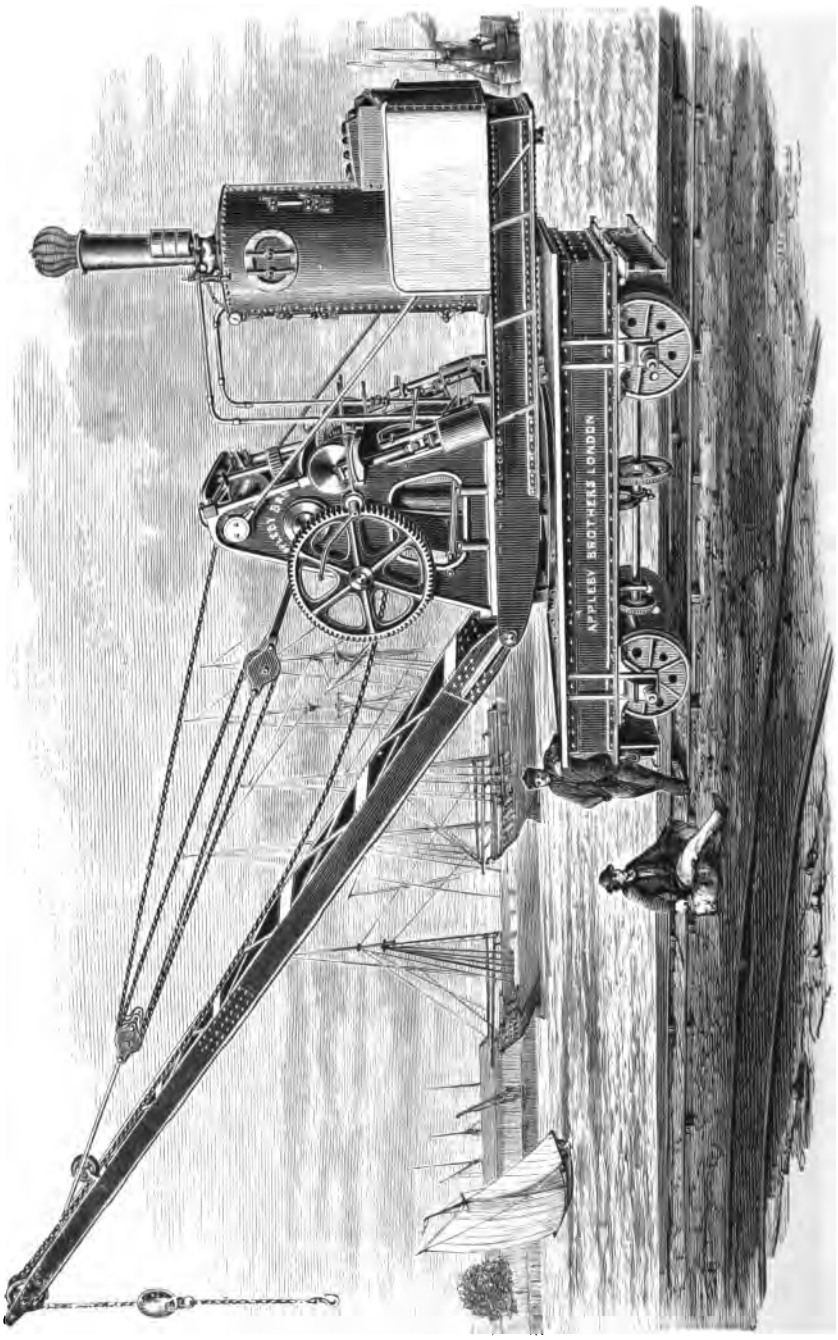


Fig. 2193

country it is found sufficient to provide a roof and back with sliding sides which are taken out when the crane is working, and replaced only in bad weather; this construction is contemplated in the subjoined prices. For cold climates a complete house is often provided having glass windows in front and sides and a door, thus protecting the driver whilst giving him a complete view of his work.

Prices.—In order to make these as complete as possible the prices are given for jibs of different kinds and for all the accessories usually required.

PRICES OF PORTABLE STEAM CRANES, Fig. 2193.

Power of crane .. .. tons	3	5	7	10
Radius of jib.. .. .. feet	15	16	17	18
Price of crane with timber jib	£390	£450	£520	£775
,, steam derrick motion	£11	£12	£13	£14
,, steam travelling motion	£22	£23	£24	£25
,, straight steel jib	£12	£15	£18	£20
,, curved ,, ...	£17	£22	£25	£30
,, rail clips or undergirders	£4	£5	£5	£6
,, felting and lagging boiler	£12	£13	£15	£16
,, galvanized iron house	£23	£25	£28	£30
,, ,, canopy	£10	£11	£12	£14
,, steam pump and fittings	£11	£12	£13	£14
,, Injector and fittings	£6	£7	£8	£8
,, Tool chest and tools	4	5	5	5
Approximate weight .. .. tons	13½	16	18	28

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

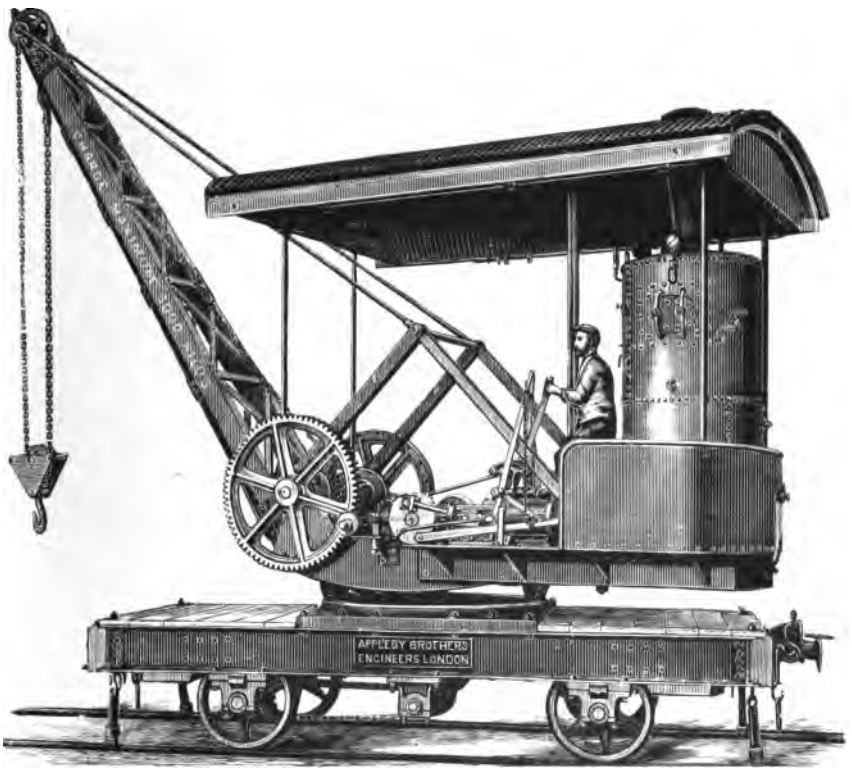


Fig. 2194.

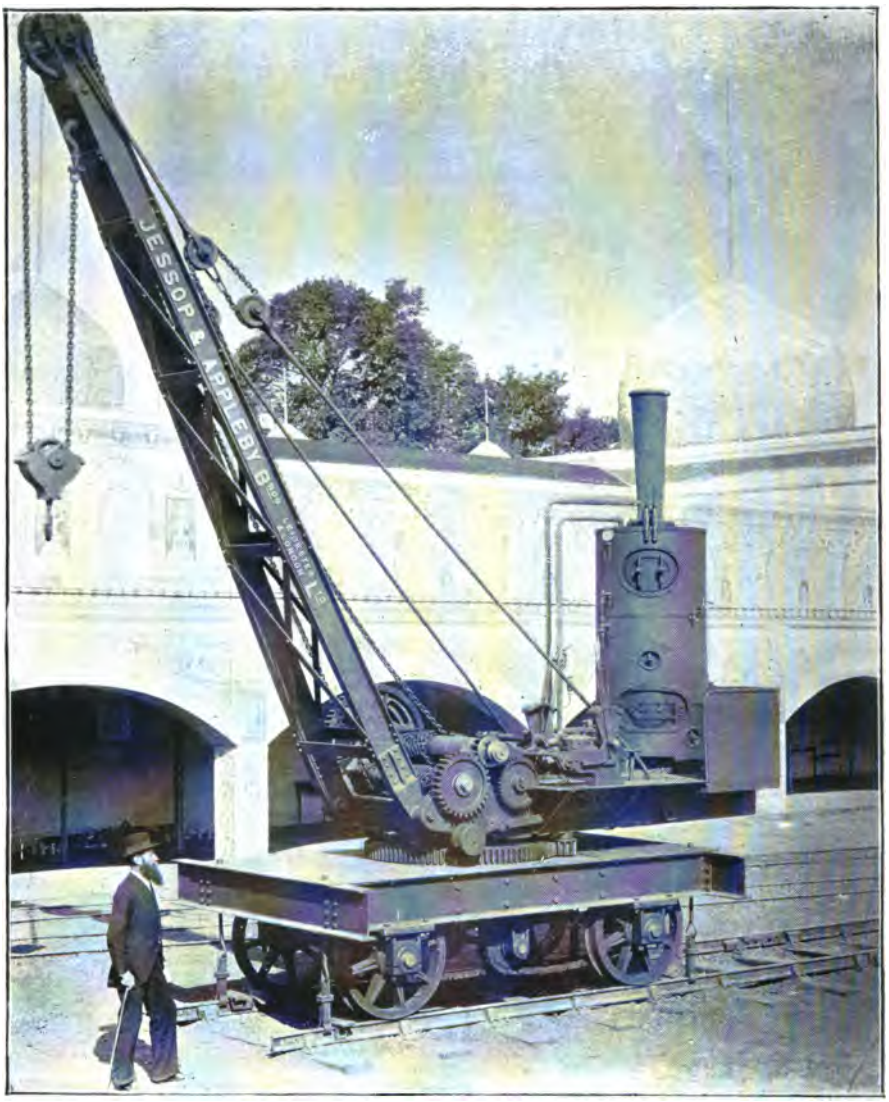


Fig. 2195.

PORTABLE STEAM CRANE TO LIFT, TURN, ALTER RADIUS OF JIB AND TRAVEL BY STEAM POWER.—The engraving Fig. 2195 (referred to on the following page) represents the construction generally adopted for cranes of all powers up to about 10 tons, unless they are required to run with railway rolling stock, or under the conditions mentioned in the immediately preceding pages.

Any of the above-named motions can be omitted, and the cost of each of them is given at page 58, so that the price of the crane can be estimated without loss of time in correspondence.

Steel is largely used in the construction of the cranes and the proportions are ample for the maximum duties respectively specified.

PORTABLE STEAM CRANES.—Figs. 2194 and 2195 represent cranes of various powers which have been used in this and other countries under widely differing conditions, amongst which may be mentioned the construction of public works, such as harbours, docks, &c., and ordinary service in iron and steel works, bridge building, railway, wharf and canal traffic.

The crane, Fig. 2194, is one of a number employed in the construction of the Panama Canal. The power is 7 tons and the wrought iron under carriage extends beyond the boiler to protect it from injury by collision; the wheels are of wrought iron with steel tyres, and the carriage has the ordinary or central buffers and draw gear shown in the engraving.

The crane, Fig. 2195, is of 5 tons power. This engraving, reproduced from a photograph of a crane employed in the installation of the Cardiff Exhibition, shows the arrangement of machinery and the recent improvements in the derrick motion for varying the radius of the jib by steam power.

The crane, Fig. 2196, on a low under carriage is of 3 tons power, and is used principally for discharging coal and general merchandise at a Colonial port, but this construction is carried out—with or without steam travelling, steam derrick, capstans, &c.—for all powers up to about 10 tons with jibs of moderate radius.

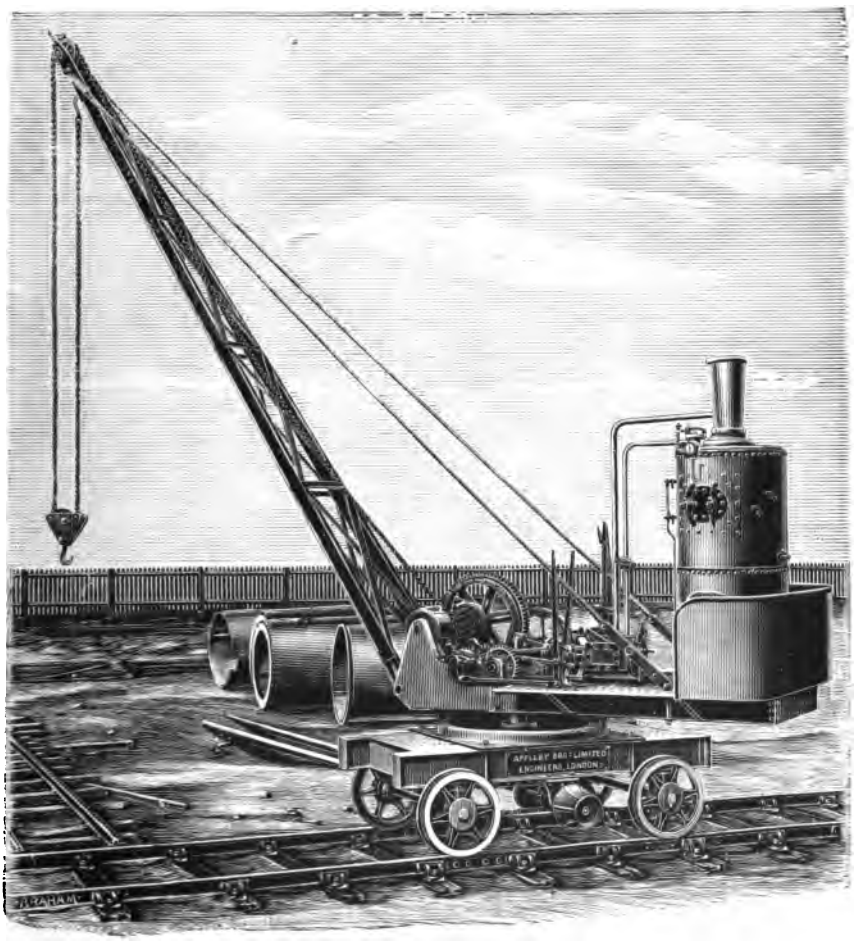


Fig. 2196.

Construction.—The details of construction and the advantages of the horizontal system are referred to at pages 39 and 53 and need not be repeated, but attention may be directed to the compactness of the arrangement indicated in the engravings, and to the convenient disposition of the levers which control the several motions and admit of the cranes being easily worked by one man.

The tie rods.—The arrangement shown in Fig. 2194 is specially adapted for cranes of large power or of long radius and will be found well worth the small extra cost, but the usual form of derrick motion and system of tie rod indicated respectively in Figs. 2195 and 2196 are quite satisfactory for cranes of moderate power and radius

Power and radius.—The proportions usually required are given below, but they are varied to any extent and cranes have been built up to 25 tons power.

Extra motions.—The prices of these, of canopies, and other accessories, will be found on the following page.

PRICES OF PORTABLE HORIZONTAL CRANES, Fig. 2194.

Power of crane	tons	5	7	10	12
Radius of jib	feet	16	16	16	16
Price of crane	..	£415	£500	£675	£750
Approximate weight ..	tons	16½	19	29	32

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

All cranes of this type can have the appliances shown in the engraving for varying the radius a few feet. The gauge of rails is 4 feet 8½ inches, but cranes have been built for all gauges from 20 inches to 12 feet.

PRICES OF PORTABLE HORIZONTAL STEAM CRANES, Figs. 2195 and 2196.

Power of crane	tons	2	3	5	7	10
Radius of jib	feet	15	15	16	16	16
Price of crane	..	£250	£315	£400	£480	£650
,, steam derrick motion	..	£15	£15	£18	£22	£25
,, ,, travelling motion	..	£20	£22	£25	£27	£32
,, curved steel jib ..	..	£10	£10	£17	£23	£25
,, rail clips or undergirders	..	£4	£4	£5	£6	£6
,, felting and lagging boiler	..	£13	£13	£14	£15	£17
Approximate weight.. ..	tons	8	11	16	18½	28

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE STEAM CRANE, Contractor's Pattern.—The type of cranes Fig. 2197 is specially designed to meet the requirements of contractors and combines the qualities usually sought of rapid working, non-liability to derangement and ample strength throughout. It is fitted with two cylinders, improved case hardened link reversing motion and double throw crank shaft; the revolving bed is of cast iron and carries the bearings for the various motions. The boiler is of the vertical cross tube type, of ample capacity and is fixed on a heavy cast iron water tank which is bolted to the revolving bed and acts as counterweight.

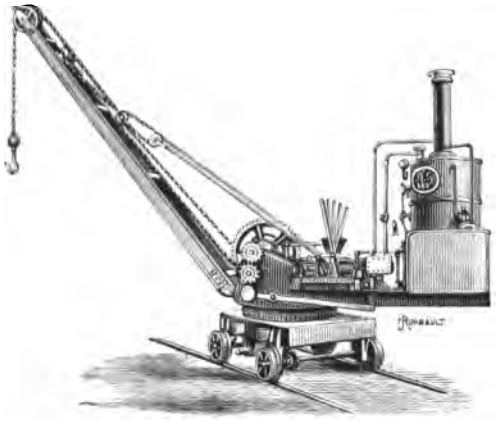


Fig. 2197.

The carriage is a heavy casting (unless otherwise arranged) with bearings for the axles carrying the travelling wheels, horns for rail clips or cross girders.

The jib is of pitch pine, splayed at the base and fitted with cast iron shoes and head or if desired it is made of wrought iron or steel and the rods as shown in Fig. 2196 The extra cost for this and for the derrick motion shown in the engraving, will be found in the subjoined list of prices.

The crane as above described is complete with best tested crane chain, brake, feed pump, spanners, &c. The levers for controlling the several motions are arranged over the foot brake in a position which gives the driver a perfect view of the load and of the machinery.

PRICES OF PORTABLE STEAM CRANES, Fig. 2197.

Power of Crane	tons	1	2	3	5	7	10	12
Radius of Jib	feet.	11	15	16	16	16	16	16
Price of Crane	..	£185	£220	£278	£350	£430	£600	£670
,, Steam Derrick motion	..	£8	£10	£11	£15	£18	£20	£20
,, Steam Travelling motion	..	£15	£20	£22	£25	£27	£30	£32
,, Straight Steel Jib ..	..	£8	£9	£10	£12	£15	£17	£18
,, Rail Clips or Undergirders	..	£4	£4	£4	£5	£5	£5	£6
,, Felting and Lagging Boiler	..	£12	£13	£13	£14	£15	£17	£18
,, Galvanized House ..	..	£12	£15	£16	£20	£23	£25	£25
,, Tool Chest and Tools	..	£4	£4	£4	£4	£5	£5	£5
Approximate weight	tons	5	8	11	16	18½	28	31

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HYDRAULIC CRANES.

The limits within which the hydraulic system can be economically employed for working cranes, hoists, capstans, opening and closing dock gates, etc., is referred to at page 3, but—as there mentioned—the facility it affords for transmitting and distributing power over large areas, frequently outweighs considerations of initial cost and relatively high working expenses.

Although installations of this kind vary too widely to be comprehensively described, the essential features in all are:—the generating station with pumping engines, boilers and connections, and the accumulator from which pressure is conveyed by the hydraulic mains to the cranes, capstans or other appliances.

It is desirable as is well known—that the provision in pumping power, sizes of main, etc., should be ample for the present and prospective number of machines. Also that the generating station should be as central as possible; but if the space available should not admit of this and great lengths of main are necessary, one or more intermediate accumulators largely aid in maintaining uniformity of pressure throughout the system.

Where the water supply is limited, or it has to be purchased, a waste water main may be laid with advantage; this being connected with each machine, the water is returned to the pumps and all waste is saved, excepting the trifling quantity lost by leakage.

Quay and jetty cranes.—Whether most of these shall be fixed or portable depends very much on the nature of the traffic but if portable cranes can be used, it is beyond question that the number required for a given aggregate duty will—in most cases—be much smaller than if fixed cranes are adopted. The type indicated in Fig. 2199 is largely used, but where quay space is restricted—and it almost invariably becomes so eventually—cranes with gantries similar to those illustrated in Fig. 2200 seem to offer distinct advantages. The clear space for trucks, locomotives, etc. to pass under the gantry practically adds another line of rails for the circulation of rolling stock and—at the same time—minimizes the distance through which the jib has to swing

Fixed cranes differ so much in design, power, radius, etc., that only a few examples can be given of those commonly used. In modern practise fixed quay cranes are rarely of less than 5 tons power.

Varying loads.—As the water displaced by the ram must be replaced for each operation—whatever the load may be—the arrangement of concentric rams (one inside the other) referred to later on, largely reduces the quantity of water used and effects a corresponding saving in the consumption of fuel.

Variable radius.—Appliances for altering the radius of the jib by hydraulic power are rarely used and are not shown in the engravings, but they are easily arranged, if required.

Working pressures.—The proportions of rams and cylinders for the cranes now referred to are those suitable for a pressure of not less than 700 lbs. per square inch (about 50 atmospheres) commonly used for hydraulic cranes.

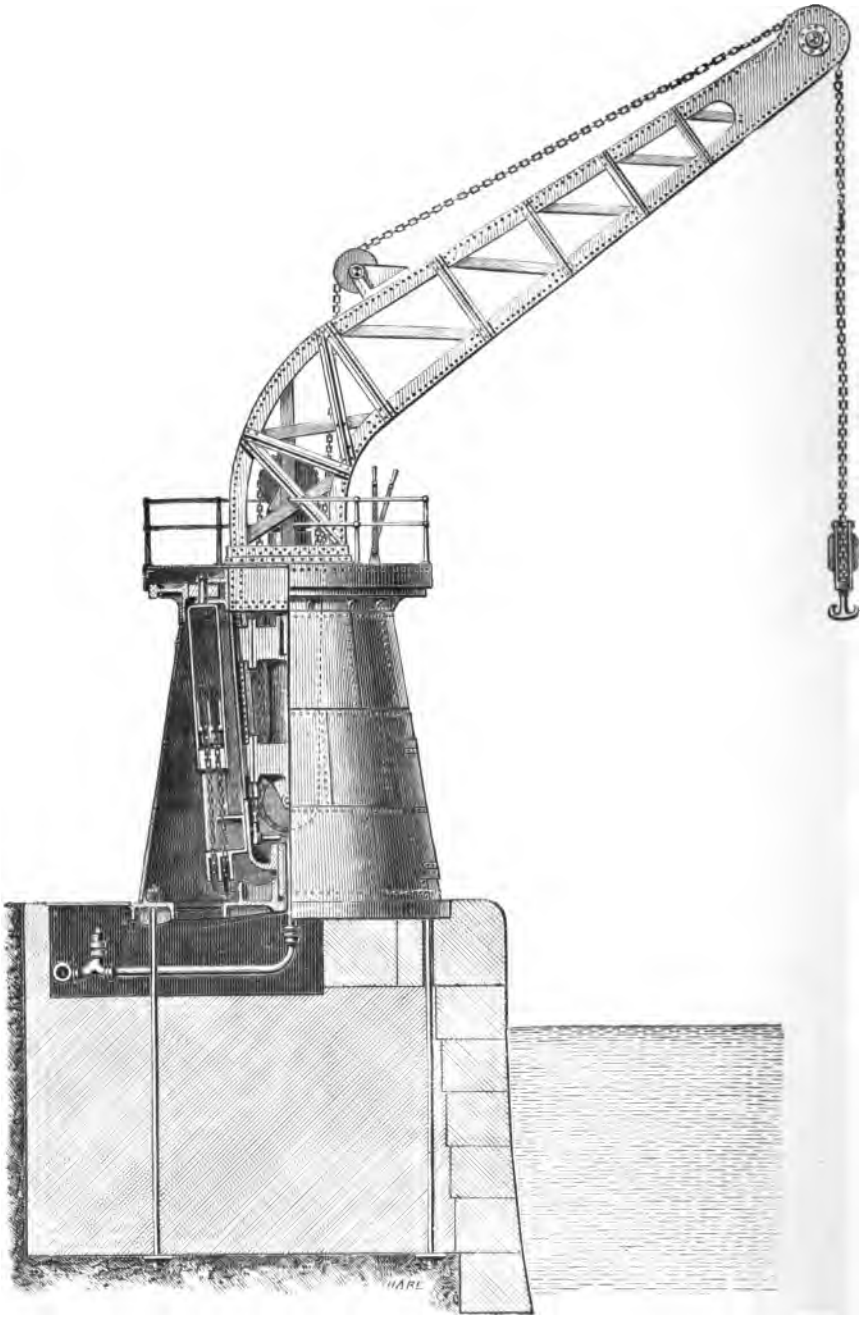


Fig. 2198.

Prices of cranes.—The cost of a crane of any given power is largely affected by the radius required, and due allowance should be made if the radius mentioned in each case is exceeded.

HYDRAULIC PUMPING ENGINES, MAINS, VALVES, &c.—The prices for these will be found under the respective headings in Section V.

HYDRAULIC MACHINE TOOLS, SHOP CRANES, &c. are referred to at pages 72 to 84 of Section IV.

FIXED HYDRAULIC CRANES.—Figs. 2198 and 2199 represent the well known type of self-contained "pedestal" cranes, respectively of 20 and 10 tons power when worked with a pressure of 700 lbs. per square inch (about 50 atmospheres).

The pedestal is built of wrought iron and carries the post (or mast) and jib as well as the lifting and slewing cylinders, valves, levers and connections; the base covers so large an area that the cost of masonry for foundations, pits, etc., required for cranes of the older construction, is materially reduced.

The levers for lifting and slewing may be arranged to work from the platform, as shown in Fig. 2198, or in the cabin as in Fig. 2199, the height in both cases giving the driver a clear view of his work and rendering him independent of signals. But if more convenient, the levers are fixed at quay level or at a distance from the crane.

The lifting rams.—In order to bring the consumption of power (referred to at page 59) as nearly as possible into relation with that necessary for working economically with varying loads, concentric rams are used, the diameters being graduated to give the desired variations in power. The number of rams usefully employed for cranes of different powers is indicated in the following table.

Prices and equipment.—The following approximate prices for cranes of the types Fig. 2198 and 2199 include the chains for the height of lift specified, connections for tube to the pressure main and all accessories ready for work.

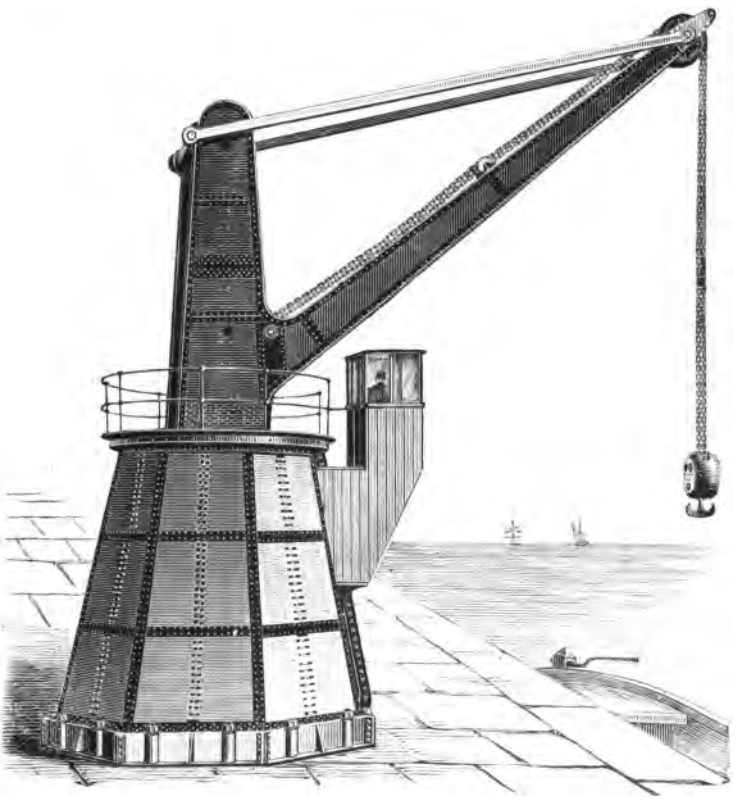


Fig. 2199.

Packing and delivery.—A saving in freight is effected if the wrought iron or steel structural work is shipped in pieces, properly marked, with an ample supply of rivets, bolts, etc, for re-erection.

THE HYDRAULIC PEDESTAL CRANE OF 20 TONS POWER, Fig. 2198, has three concentric rams and has been built for service in docks, main line goods stations, etc in this country and abroad.

The central ram is equal to working loads up to 7 tons; the two outer rams are combined for loads up to 14 tons, and all three are used for the maximum load of 20 tons.

THE 10 TONS HYDRAULIC PEDESTAL CRANE, Fig. 2199, has two rams which are used in the manner last described. The small ram is equal to a load of 4 tons, and the two rams are employed for lifting up to 10 tons. Fixed cranes of less than 5 tons power rarely have more than one lifting ram.

PRICES OF HYDRAULIC PEDESTAL CRANES, Figs. 2198 and 2199.

Power of crane	tons	3	5	10	15	20
Number of rams	..	one	two	two	three	three
Radius of jib	feet	30	30	30	30	30
Height of lift	,,	35	35	35	35	35
Price of crane	..	£525	£605	£804	£1000	£1200
Approximate weight	tons	17	20	28	36	45

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

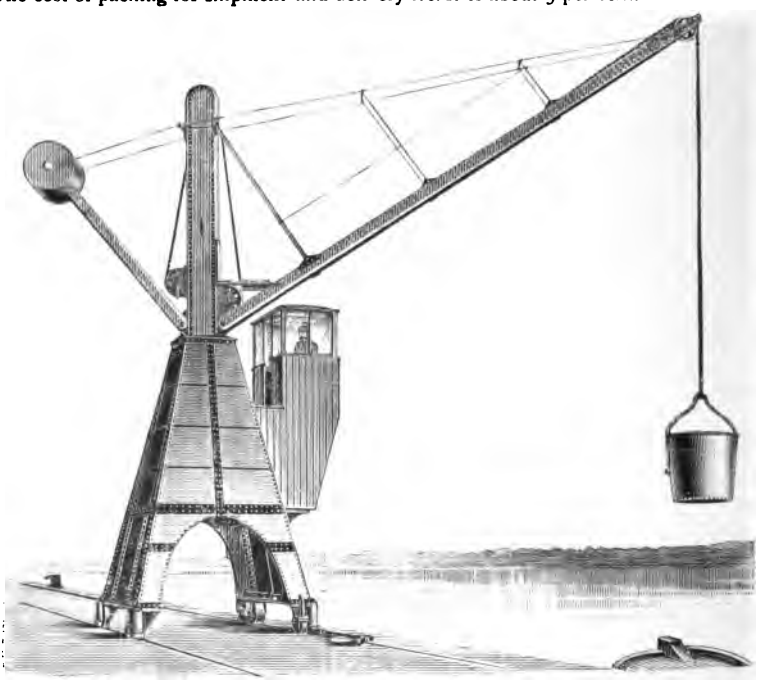


Fig. 2200.

HYDRAULIC GANTRY CRANES.—Fig. 2200 represents the construction in general use for docks, wharves, etc., but it is quite as easy, and costs but little more, to build the gantry as shown in Fig. 2173; this admits of free circulation of rolling stock beneath it and gives space for an additional line for traffic.

The merits of the gantry system have been referred to in connection with steam cranes (see pages 29 to 34), and attention need only be directed to—

1.—The facility afforded for concentrating crane power wherever it may (even temporarily) be required.

2—That although commanding a large area, the crane occupies less quay space than any other type.

3—That it allows free circulation for traffic close to the water's edge—always the most valuable part of the quay.

4—The height of jib provides an ample margin for clearing the largest vessel, even when light, and the position of the levers affords the driver a clear view of his work.

The Gantry is built of wrought iron and mounted on steel travelling wheels, or on iron or timber sleepers which are fixed to the ground if the crane must be stationary. The weight of the structure and the large base give ample stability and—for portable cranes—this is insured by clips at each end of the undercarriage for attaching it to the rails.

Duplex rams.—Cranes of this type are so frequently required for working loads which rarely exceed half a ton to one ton, that some economy in working expenses is effected by having the concentric rams referred to in the remarks at page 59 on "Varying loads," and the prices of such cranes will be found below.

The rams are made of the proportions best suited to the traffic, but the diameter of the internal ram is usually adapted for loads up to about 1 ton.

Equipment.—The crane is complete with lifting and slewing cylinders, chains or flexible steel wire rope and all accessories ready for work, including the coupling for connecting the pressure pipe. The pressure main is usually laid in a trench near to the crane track and provided, at intervals, with valves for connection with crane.

PRICES OF PORTABLE HYDRAULIC CRANES, Fig. 2200.

Power of crane .. .. tons	1½	2	3	5
Radius of jib .. .. feet	30	30	30	30
Height of lift .. .. ,,	35	35	35	35
Price of crane with single ram	£560	£637	£745	£940
Ditto ditto concentric rams	£675	£705	£820	£1015
Approximate weight .. .. tons	19	22	27	35

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

FIXED HYDRAULIC GANTRY CRANES are precisely as last described, excepting that undergirders to fix to the ground are substituted for the travelling carriages shown in Fig. 2200.

The prices are approximately 5 per cent. less than for portable cranes of equal proportions.

GOODS WAREHOUSE HYDRAULIC CRANE.—The type of crane illustrated by Fig. 2201 is adapted for loads up to about 3 tons, and for the limited height of lift required for transferring goods from trucks to the receiving platform for distribution by rail or road and for similar service.

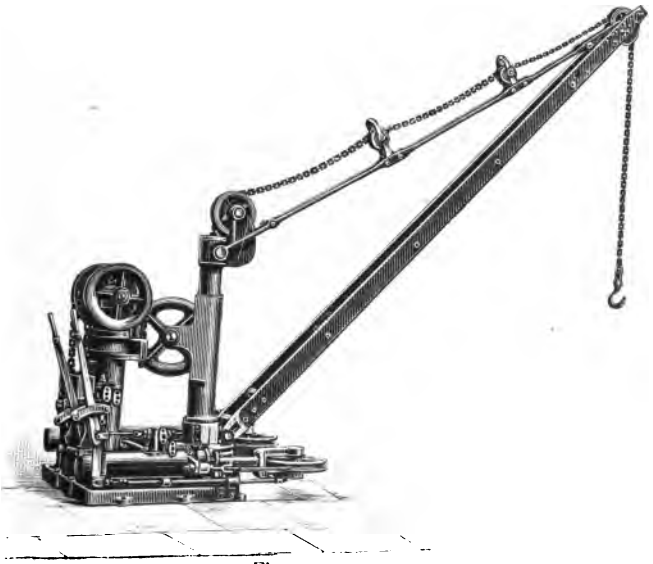
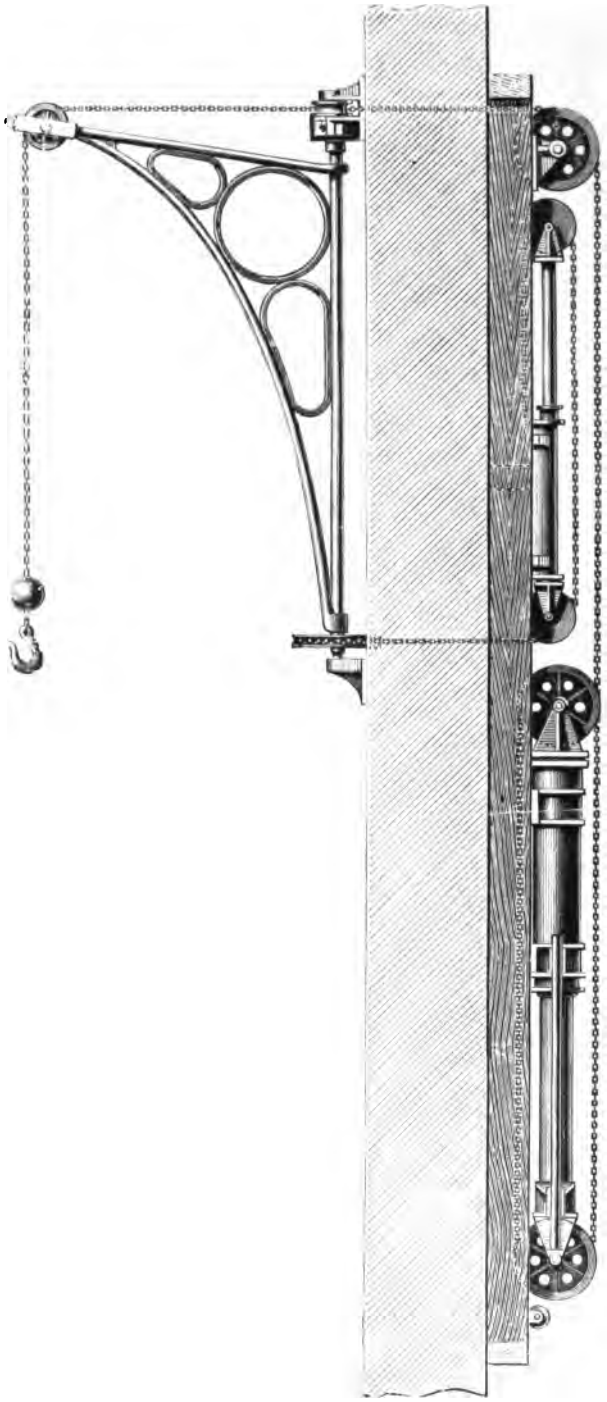
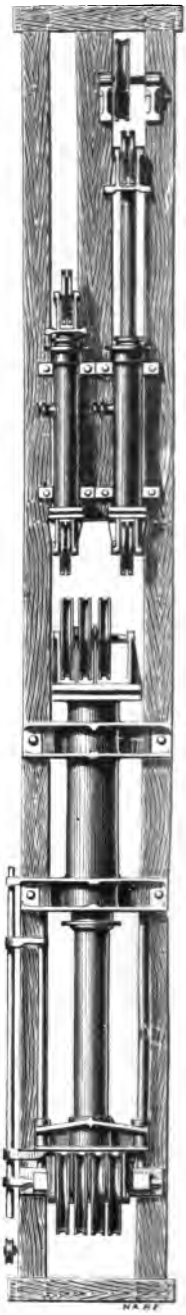


Fig. 2201.



Side Elevation.

Fig. 2202



End Elevation.

Fig. 2203

The cylinders for lifting and slewing, and all appliances for working, are carried on the bed plate which is prepared for bolting to timber or masonry, so that the cost of foundations forms an insignificant item in the total outlay.

This system—in conjunction with an inexpensive form of accumulator—is well adapted for goods stations where a few cranes are required. If surplus power does not exist, the hydraulic pressure may be supplied from a direct-acting pump, or the pressure pumps may be driven by a steam, gas, or oil engine.

PRICES OF GOODS WAREHOUSE HYDRAULIC CRANES, Fig. 2201.

Power o. crane .. .. tons	1	1½	2	3
Radius of jib .. .. feet	12	12	12	12
Height of lift .. .. ,,	16	16	16	16
Price of crane	£120	£133	£155	£188
Approximate weight .. .. tons	3½	4	5	6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

Hydraulic wall cranes.—Figs. 2202 and 2203 illustrate cranes which have been in use for many years in an extensive range of dock warehouses, for receiving and delivering bales, bags, casks, and other packages.

The jib, shown in Fig. 2202, is of wrought iron and is arranged to reach to the centre of the top door and to each of those below, including that in the basement. But if two ranges of doors are to be served by one set of machinery, the jib is constructed of steel of necessary length and proportions, fixed centrally between two doors on the upper floor.

As will be seen from the engraving Fig. 2203 the lower cylinder and ram are used for lifting and the two upper cylinders for swinging the jib, but these cylinders may be fixed in any other more convenient position.

Cranes of this kind are required to work under conditions varying too widely to admit of them being tabulated, but the following data will suffice for approximately estimating the cost of hydraulic machinery for most warehouses of the usual types

The prices include the cylinders, rams and accessories for them and the lifting chain or flexible steel wire rope, but not the jib and top and bottom carriages, which must frequently be made to special designs.

PRICES OF HYDRAULIC WAREHOUSE JIB CRANES, Fig. 2202 and 2203.

Power of crane .. .. tons	½	¾	1	1½
Height of lift .. .. feet	45	45	45	45
Price of lifting cylinder and chain	£105	£115	£125	£140
Do. do. and slewing cylinder and chain ..	£125	£135	£150	£170
Extra per foot in height of lift	£3	£4	£5	£6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

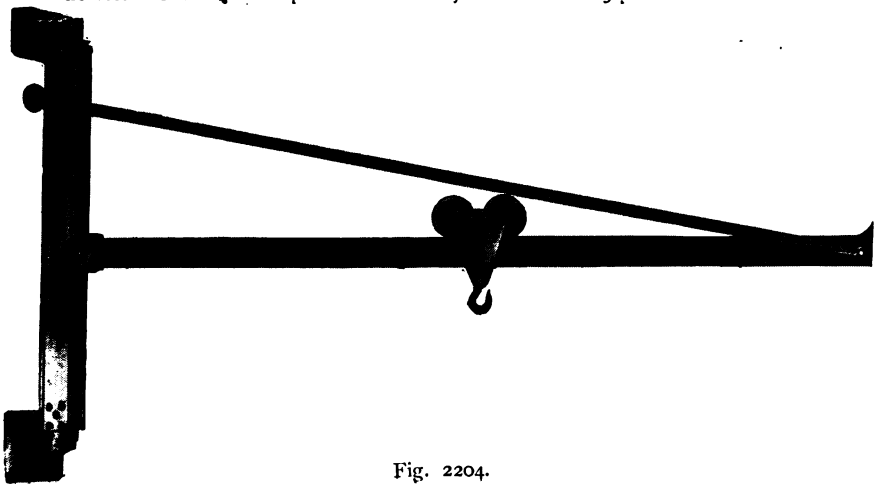


Fig. 2204.

HYDRAULIC WALL OR COLUMN CRANES of the type Fig. 2204 are used principally for service in engineering works, foundries, forges, boiler shops, etc., and work at a pressure of 1500 lbs. per square inch (about 107 atmospheres), generally adopted for the rivetting and other machines referred to in section IV.; but they can be adapted to work with the lower pressure usually employed for hydraulic cranes and do good service in warehouses and some industrial operations.

The lifting cylinder is between the side frames which form the post, and the rollers attached respectively to the tension bars and the jib, reduce friction to a minimum when the jib and load are lifted or lowered. The valve which controls the hydraulic pressure is fixed in any convenient position. The load is traversed horizontally and the jib slewed by hand.

The following are usual proportions in regard to power, radius, and height of lift, but these are varied to almost any extent to suit the work for which the crane is required. The range of lift may be increased at a cost of £6 to £10 per foot of extra height.

PRICES OF HYDRAULIC WALL CRANES, Fig. 2204.

Power of crane ..	tons	½	1	2	3	4	5	6	7	8
Radius of jib ..	feet	20	20	20	20	20	20	24	24	24
Height of lift ..	,,	5	5	5	5	5	5	8	8	8
Price of crane ..	..	£55	£68	£105	£115	£135	£145	£200	£230	£255

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

FIXED HYDRAULIC CRANE WITH ROTATING JIB.—The diagram Fig. 2205 illustrates an entirely self-contained crane which can be fixed where desired, and serve any part of the area commanded by the jib which, in the crane illustrated, is 40 feet diameter.

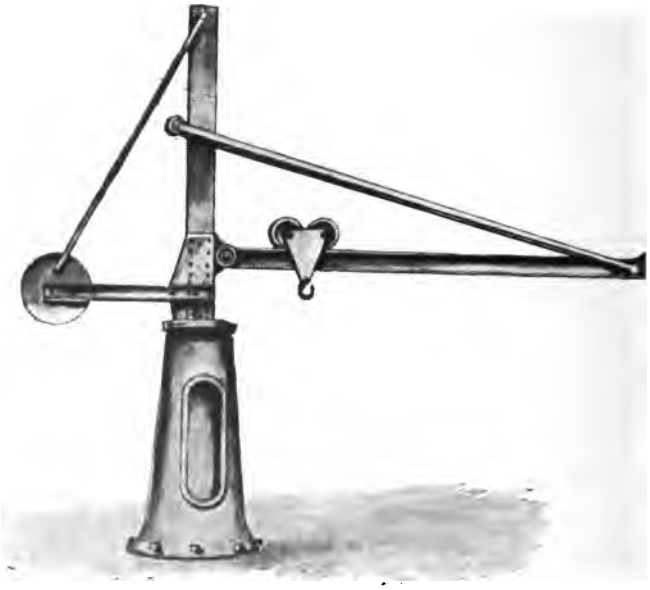


Fig. 2205.

This form of crane is largely used in machine shops, foundries, forges, &c., and it is also made with a strut to support the jib in the same manner as the Foundry Crane Fig. 2206; but the tension bar arrangement shown in the engraving, which leaves a perfectly clear space below the jib and allows the whole of the floor space to be utilized, is generally preferred.

The jib is slewed by hand and the load is usually traversed by hand power, but mechanism for this purpose can be added if desired.

PRICES OF FIXED HYDRAULIC CRANES, Fig. 2205.

Power of crane	tons	1	2	3	4	5
Radius of jib	feet	20	20	20	20	20
Height of lift	,,	5	5	5	5	5
Price of crane	..	£140	£163	£185	£200	£230
Approximate weight	tons	5	6	6½	7½	8

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

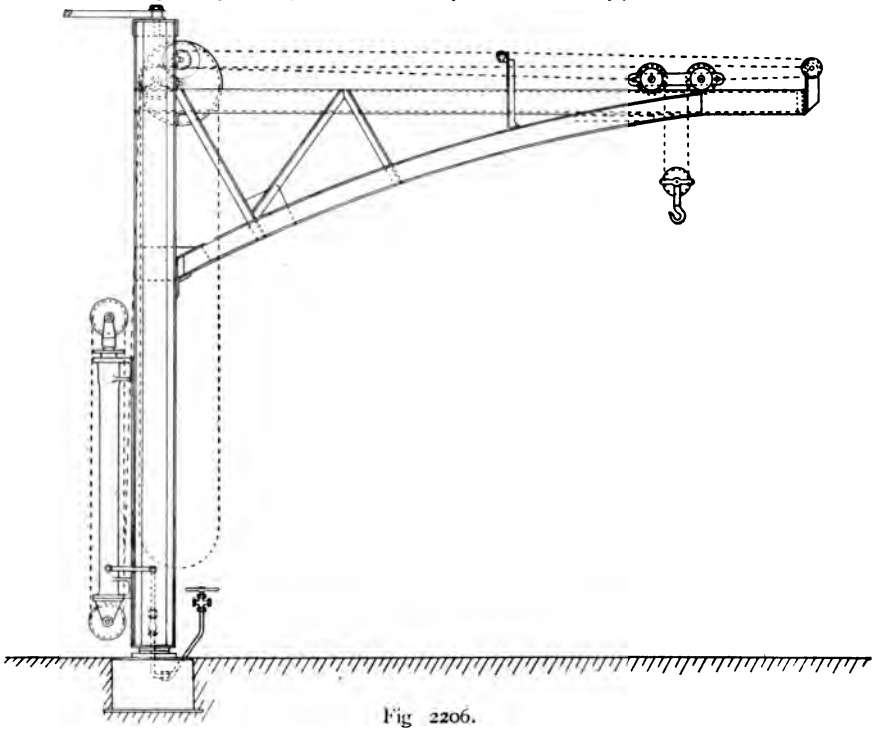


Fig 2206.

WROUGHT IRON HYDRAULIC SWING CRANE.—The very useful type of crane represented by the diagram Fig. 2206 makes a complete revolution and has a radius of 24 feet, the height from floor to underside of jib being 20 feet. The lifting power is 3 tons, but this and the other proportions above mentioned can be varied indefinitely.

The hydraulic pressure is conveyed through the pivot around which the crane rotates ; the valve for the hydraulic pressure is in the position shown, or elsewhere if more convenient.

The load is traversed along the jib by gear worked by hand power, with V-grove pulley for rope or chain as shown ; but a separate hydraulic cylinder and ram for racking is preferable for cranes which are worked continuously.

The price of a crane of the proportion indicated, to lift three tons and
traverse the load by hand power is £115 0 0
,, With hydraulic racking gear £140 0 0

INSTALLATIONS OF HYDRAULIC MACHINERY for Docks, Wharves, &c., differ from each other so widely in extent and details (almost invariably involving some special features), that it is difficult to make a selection which may be regarded as fairly representative. But the following outline Specification of Machinery for Import and Export Quays recently constructed, may perhaps be considered typical of a modern and economical plant for loading or discharging miscellaneous cargo.

Engines and Boilers.--Two of the pumping engines (usually supplied with steam from three of the boilers) work 60 per cent. of the crane power, the third set of pressure pumps being in reserve or employed only quite exceptionally.

Three of the boilers will supply steam for all three engines in case of need, leaving one boiler always in reserve.

Accumulators.—It was found convenient to locate the pumping station at one end of the Quays, and a second Accumulator is provided to equalise the pressure throughout the system.

The Cranes are of the most modern type, and the Portable Gantry Cranes have gear, worked by manual power, for traversing them to any part of the Quay. The clear height and span of the Gantries admit of rolling stock circulating beneath them.

Discharging coal, grain, &c.—Vessels carrying these cargoes are discharged by grabs, similar to those illustrated by Figs. 2237 and 2241, used in conjunction with any of the cranes. Some data relating to the quantity of work performed by these appliances, and the working expenses, will be found at pages 93 to 100.

Outline specification of plant:—

Three sets of compound pumping engines to work with a steam pressure of 150lbs. per square inch, and to supply hydraulic pressure of 700lbs. per square inch.

Four mild steel Lancashire boilers with circulating tubes in the flues, and all fittings and connections.

Two hydraulic accumulators, with weight cases and automatic stopping and starting gear to engines.

Seven portable hydraulic gantry cranes of the type Fig. 2200 but to admit rolling stock beneath, and with rams respectively for 15 and 30 cwt. (750 and 1500 kilog.) and hand power travelling motions; the radius of the jibs is 45 feet (about 13½ metres).

Three fixed gantry cranes as above, but without travelling wheels, and with duplex rams for 25 and 50 cwt. (1250 and 2500 kilog.)

One fixed crane as above, but with duplex rams to lift 2½ and 5 tons (about 2500 and 5000 kilog.)

One hydraulic pedestal crane, similar to Fig. 2197, of 10 tons (10000 kilog.) power, with duplex rams.

One hydraulic capstan.

Three grab buckets, Fig. 2237, for discharging coal, coke and ore.

Three grab buckets, Fig. 2241, for working cargoes of grain and seeds.

The cost of the installation as above described is about £12500

The hydraulic pipes and connections for pressure and exhaust water, returned to the pumps, with joints, rings and bolts, the connections between mains and cranes, including valves, &c., cost about £3300

HYDRAULIC COAL TIPS and machinery for loading vessels with coal and ore will be referred to in detail in Section V.

HYDRAULIC OVERHEAD TRAVELLING CRANES.—Although cranes of this type, designed and built by the writer's firm, for service in Main Line Locomotive Shops, give excellent results, it is doubtful whether (on the whole) the transmission of power by hydraulic pressure—for this purpose—compares favourably with other systems referred to in the following pages.

ELECTRIC CRANES.

The principal advantages gained by the use of electric motors are: (1) a saving in consumption of fuel; (2) convenience and flexibility in working, and (3) absence of dirt from coal, ashes, &c.

The saving in fuel arises from two causes; the first is the high efficiency of electrical transmission compared with that obtained by other modes of transmitting power; the second is, that all working parts are at rest and no waste goes on when the crane is not used.

Conductors or Cables, which supply the current to the motors are usually arranged as follows:—

For temporary purposes, or where a great length of wharves has to be served by portable cranes, bare conductors are carried on wood or iron poles, and the current for cranes which are not required to make a complete revolution, may be taken directly from overhead conductors by a trolley or sliding contact. If the crane must rotate completely, contact boxes may be fixed on the poles or in the ground, at intervals, and the cable led from them through the post or pivot of the crane, to the motor.

For permanent use the conductors are laid underground, and the cranes are supplied with current from the junction boxes, or by means of a slotted conduit and sliding connection.

Electric jib and derrick cranes.—There is no waste of time in getting up steam, or in bringing fuel and water to the crane as when steam driven, and the large compound engines and stationary boilers employed for driving the electric generators are much more economical of fuel than the small crane engines and boilers, however well designed and constructed.

In the case of fixed steam cranes supplied from distant boilers, the loss in condensation and leakage in pipes renders them, usually, even less economical than the self-contained steam crane.

Electric cranes of these types are usually driven by one motor; in some cases, however, two or more may be used with advantage. The current is led to the motor through the centre pivot; but, as already mentioned, a more simple connection suffices for cranes which do not slew through a complete circle.

Electric overhead travelling cranes.—For the reason above referred to, the loss of power in electrical transmission is much less than with cranes driven by rope or square shaft.

One motor driving the first motion shaft which would be driven by the rope or square shaft, usually suffices for cranes of moderate power. But cranes of large power are frequently equipped with three motors—one for lifting, another for travelling and a third for cross traversing. This arrangement does away with intermediate gear and admits of each motor being of the power required for the work to be performed, so that it will always work at its most economical load.

These cranes almost invariably pick up their current by trolleys or sliding shoes running on a cable fixed in any convenient position and extending along the whole range of travel.

Alterations to existing cranes.—From the foregoing remarks it will be seen that most well constructed cranes can be converted to work by electric current.

Distribution of electrical power.—Speaking generally, electricity compares favourably with other methods of distributing power to machines which are worked intermittently, and a considerable saving may be confidently anticipated where a number of cranes or other machines are in use. This is especially noticeable where power, employed for other purposes, leaves a surplus for driving the generating dynamo.

The details required for estimates consist principally of type, power, proportions and number of cranes or machines to be driven; the pressure or tension available (if it is supplied from an existing dynamo) together with such data as may be necessary with regard to the plant to be provided, provisions for extension, &c.

The prices of electric cranes do not differ materially from those of similar type and proportions driven by steam, rope, or square shaft including the accessories requisite for driving the two last named, so that approximate estimates of cost may be based on the prices which will be found on the preceding and following pages. But some details are given with reference to:—

Electric Titan and Goliath cranes at page 70.
Electric fixed jib cranes at page 45.
Electric portable cranes at page 53.
Electric derrick cranes at pages 88 and 90.
Electric overhead travelling cranes at page 119.

ELECTRIC LOCOMOTIVE CRANES which have to travel long distances, may take their current by means of a trolly or shoe sliding on rails or copper strips laid underground, as described in the preceding remarks on "Conductors for permanent use" For a short travel, the cable may be fixed (about) centrally, sufficient length being provided to reach to the distance required each way.

INSTALLATIONS FOR SUPPLYING POWER AND LIGHT vary so widely in extent and completeness, that it is impossible to treat this branch of the subject in detail, but the following abstract of a specification indicates the nature and cost of a complete installation, comprising highly economical engines, boilers, dynamos, conductors, quick working cranes, and electric lifting appliances—with ample surplus power for future extensions—for a long line of quays, where exceptionally low temperature precludes the use of hydraulic or steam cranes.

The plant comprises:—

Four compound Cornish boilers with fittings, feed pumps, pipes, &c., wrought iron chimney and fire bricks, fire clay, &c. for setting boilers and lining chimney.

Four compound high speed engines of the highest efficiency, and

Four dynamos, each mounted on the engine bed plate and coupled to the end of the crank shafts of the respective engines. These dynamos are capable of an output of 305 amperes 225 volts at 280 revolutions per minute.

Switchboard of enamelled slate with voltmeter, switches, ammeter and accessories.

Copper cable between dynamos and switchboard.

Four shunt resistances and 2650 yards (about) of copper conductor of the requisite sections, insulators, trolleys for collecting current for cranes, &c.

Sixty lamp posts with lanterns and internal fittings, 1600 yards (about) of copper cable, and 120 insulators.

The machinery comprises:—

Twelve portable electric gantry cranes of the type Fig. 2173, to lift 1 ton at a speed of 100 feet per minute and to slew at a proportionately high speed. The radius of the jib is 45 feet and the height admits of working the largest ship afloat, when light.

The motors for these cranes are capable of giving off 10 brake horse power at a normal speed, and they are fitted with all appliances to ensure economy in working and maintenance, and to give easy control.

The machinery for lifting, slewing, lowering by brake, &c., is similar to that used in steam cranes, and this—as well as the driver's platform—is enclosed in a neat house with doors, windows, &c.

Six portable electric cranes of 5 tons power of the type Fig. 2195, and of the construction described at page 56, excepting that an electric motor of 20 brake horse power is substituted for the ordinary engine and boiler.

Travelling motion.—Each undercarriage is provided with gear to be worked by one or two men for moving the crane when necessary.

Cable and collecting trollies for conveying the current to the motors are furnished, as above indicated.

The cost of the installation, ready for erection, is about £18,000, and the cost of packing for shipment and delivery f.o.b. is about 5 per cent.

ELECTRIC BLOCK SETTING PLANT.—The following description relates to plant which has manipulated more than 100,000 blocks of exceptional size in one year, with at least as much convenience and economy as would have been obtained if the machinery had been driven by steam power in the ordinary manner.

The conditions under which machinery of this kind is used makes it difficult to compare the details of working expenses with those incidental to other systems, but the general results have been in every sense satisfactory and point to the conclusion that, with dynamos driven by economical engines, electric power costs considerably less than that furnished by separate small engines and boilers. One man attends to the three machines referred to, all the rest of the work being done by labourers, and there is some saving in incidental charges.

ELECTRIC TITAN OF 100 TONS POWER.—This crane is not illustrated, but the following details relating to the proportions and construction of the crane furnish a basis for determining the arrangement of machinery to fulfil conditions similar to—or differing from—those now referred to.

The jib, or cantilever, projects a distance of 66 feet beyond the front travelling wheels, and blocks up to 100 tons weight can be deposited at any point on either side, or on the face of the mole, the top formation width of which is 40 feet.

The travelling gear consists of sixteen steel flanged wheels which travel on four lines of heavy steel rails, the gauge of the outer rails being 10 feet; the power for travelling is transmitted from the electric motor.

The motor, which provides the power for all motions is compound shunt wound, and the current is conveyed to it by bare copper conductors carried on porcelain insulators attached to wood poles.

The dynamo is of 24,000 Watt power and is driven by a steam engine of 35 horse power.

The efficiency and cost of plant.—The efficiency is 65 per cent, and the cost is not more than that of a Titan of similar proportions driven by steam power.

ELECTRIC-HYDRAULIC GOLIATH CRANE OF 100 TONS POWER. The construction of the gantry generally resembles that shown in Fig. 2157 but the machinery consists of a highly efficient combination of electric and hydraulic power, each used under the most favourable conditions.

The travelling gantry is built of mild steel and is mounted on four compensating bogie trucks, each with two steel flanged wheels (8 wheels in all) for a gauge of 18 feet 6 inches; travelling motion is transmitted to these wheels from the electric motor, as described below. Heavy steel rails laid between the lines of blocks form the track, and the Goliath conveys the suspended block to a transfer platform, which takes the place of the block truck indicated in the engraving, and mentioned in the description of the Goliath, Fig. 2158.

The lifting machinery consists of two hydraulic cylinders and rams with a range of stroke of 12 inches; hydraulic pressure is supplied to them from a set of pumps driven by an electric motor on the gantry, which also provides the travelling motion. The cylinders are fixed, and the lower ends of the rams have loops for attaching them to lifting Lewises placed in the blocks to suit the centres of the rams.

The motor makes 630 revolutions per minute and the speed is reduced by worm and wheel gear to suit that requisite, respectively, for driving the hydraulic pumps and the travelling wheels.

The dynamo, which supplies the current for this and other motors and for electric lighting, is driven by an existing engine which has the necessary surplus power.

ELECTRIC-HYDRAULIC BLOCK SHIPPING MACHINE OF 100 TONS POWER.—The appliances for lifting and traversing the block are mounted on a strong steel undercarriage in a manner similar to that indicated in Fig. 2155, but there are two steel cylinders and rams each with a stroke of about 23 feet. The cylinders are fixed, and the centres of the rams coincide with those of the Lewises in the blocks; the connection with the rams is the same as that adopted for the Goliath last referred to.

The hydraulic pumps and travelling motion are driven by one motor, the speed being reduced by worm and wheel gear to that suitable for each purpose. The motor is similar to that for the Goliath and is supplied with current from the same source.

HAND POWER CRANES.

FIXED HAND POWER CRANE WITH CURVED JIB, Fig. 2207.—This construction is adopted where the clear space under the jib must be greater than that obtained with jibs of the ordinary type, which are illustrated and described in the following pages.

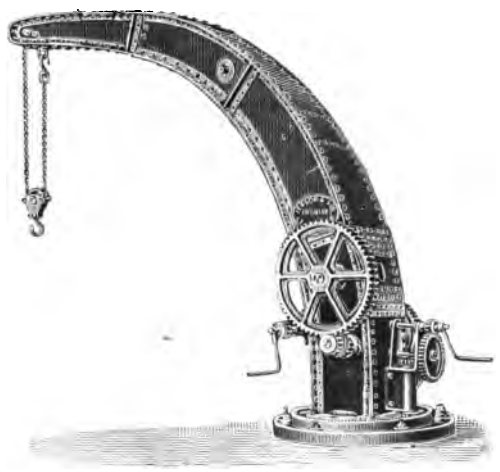


Fig. 2207.

The structure is a wrought iron or mild steel box girder which extends below ground level and forms a substitute for crane post.

The lifting gear has two or more speeds or "purchases" in proportion with the power of the crane, as well as brake and pawl capable of sustaining the full load.

The slewing gear, fixed in the position shown in the engraving, is of ample power and is complete with handles, top ring, toe plate, foundation bolts and all accessories ready for erection and use.

The lifting chain is of best, best quality and extends to ground level; the sheave of the lifting block works on a turned steel pin, and the swivel hook is made of best Yorkshire iron.

The following proportions are generally useful, but they may be modified to any extent desired.

PRICES OF HAND POWER CURVED JIB CRANES, Fig. 2207.

Power of crane	tons	5	10	15	20	30	40
Radius of jib	feet	16	18	18	20	23	25
Price of crane	..	£175	£315	£420	£590	£765	£945
Approximate weight ..	tons	5¾	11½	17	22	36	40

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

FIXED HAND POWER CRANE. – Fig. 2208 represents a crane of 30 tons power and is a type which has been constructed for the British and several Colonial and Foreign Governments, docks, &c.

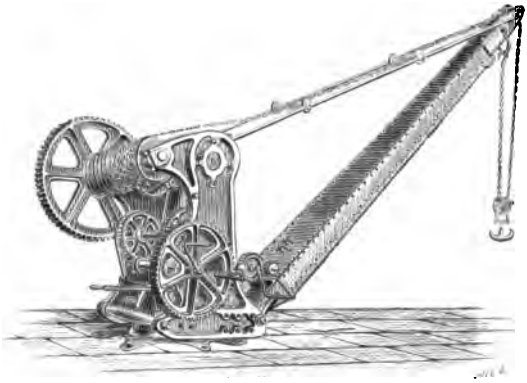


Fig. 2208.

The gear is single, double and treble purchase; the pinions and pawl wheel are of cast steel and the shafts are of best iron or mild steel truly turned and adjusted.

The crane post is of best hammered iron or mild steel and is keyed in a massive foundation plate with the slewing ring and turned roller around which the anti-friction rollers revolve.

The jib is of box section and provided with a foot piece which carries the above named anti-friction rollers.

The chain is of best, best quality and reaches to ground level; the sheave in the lifting block works on a turned steel pin and the hook (or loop, if desired) is made of best Yorkshire iron.

PRICES OF FIXED HAND POWER CRANES, Fig. 2208.

Power of crane .. .. tons	25	30	40
Radius of jib .. .. feet	20	25	28
Price of crane	£582	£735	£945
Approximate weight .. .. tons	22	30	40

The cost of packing for shipment and delivery f.o.b. costs about 5 per cent.

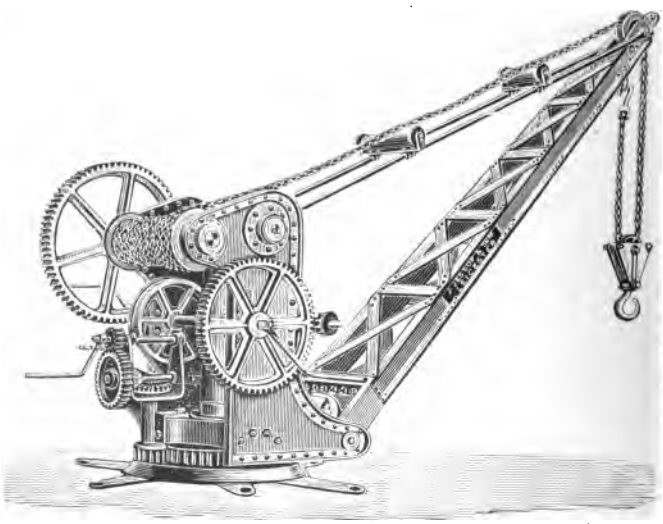


Fig. 2209.

FIXED HAND POWER CRANES WITH WROUGHT IRON FRAMES.—The arrangement, materials and finish of the crane Fig. 2209 are similar to those last described, with the exceptions that the side frames are made in wrought iron or mild steel strengthened with angle irons, and the bearings are bolted or rivetted on, as shown in the engraving.

PRICES OF FIXED HAND POWER CRANES, Fig. 2209.

Power of crane	tons	3	5	10	15	20
Radius of jib	feet	14	15	18	18	20
Price of crane	..	£115	£158	£300	£420	£600
Approximate weight	tons	3½	5½	11½	15	20

The cost of packing for shipment and delivery f.o.b. costs about 5 per cent.

FIXED HAND POWER CRANES WITH PLATE IRON SIDES.—Fig. 2210 represents a crane of 10 tons power of the type largely employed for Railway goods traffic and similar service.

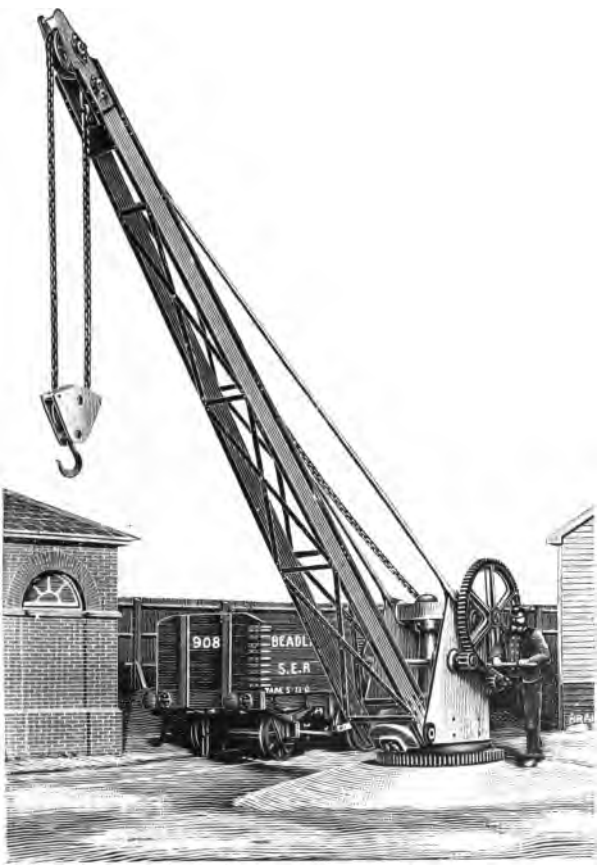


Fig. 2210.

The side frames are of wrought-iron boiler plate, to which are rivetted cast-iron bosses, properly machined for carrying the several shafts, and connected top and bottom by cast-iron stretchers. The gear is single and double purchase for cranes up to 20 tons power, a treble purchase being added for cranes to lift more than 20 tons. The post is of forged iron or steel of ample dimensions, and is turned to fit freely in the stretchers. The base plate is a massive casting, the race path of which is machined for taking the anti-friction roller in the foot of the jib. The slewing gear is carried by a cast-iron column attached to the back of the crane.

The chain is short-link best best-quality tested to Admiralty proof strain, of ample diameter and length; the materials and workmanship throughout are the best of their respective kinds, and the crane is supplied complete with handles and the usual accessories.

PRICES OF FIXED HAND POWER CRANES, Fig. 2210.

Power of crane	tons	3	5	10	15	20
Radius of jib	feet	14	15	18	18	20
Price of crane to lift and slew		£90	£128	£256	£350	£500
Extra for derrick motion		£12	£15	£20	£25	£32
,, ,, wrought-iron jib		£5	£8	£10	£17	£25
,, ,, gun-metal bushed bearing ..		£5	£6	£8	£10	£15
Approximate weight	tons	4	5½	12	15	20

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

FIXED HAND POWER CRANES WITH CAST IRON SIDES.—The side frames and the arrangements of the lifting and slewing motions are similar to those shown in Fig. 2210, with equal margins of safety when working the respective maximum loads.

The timber jibs are made of pitch pine, and wrought iron jibs are of the lattice construction shown in Fig. 2210. The prices are as given in the foregoing list.

THE FIXED HAND POWER CRANE, Fig. 2211 has side frames of wrought iron or mild steel of channel section, the gearing being carried in strong castings, attached to them.

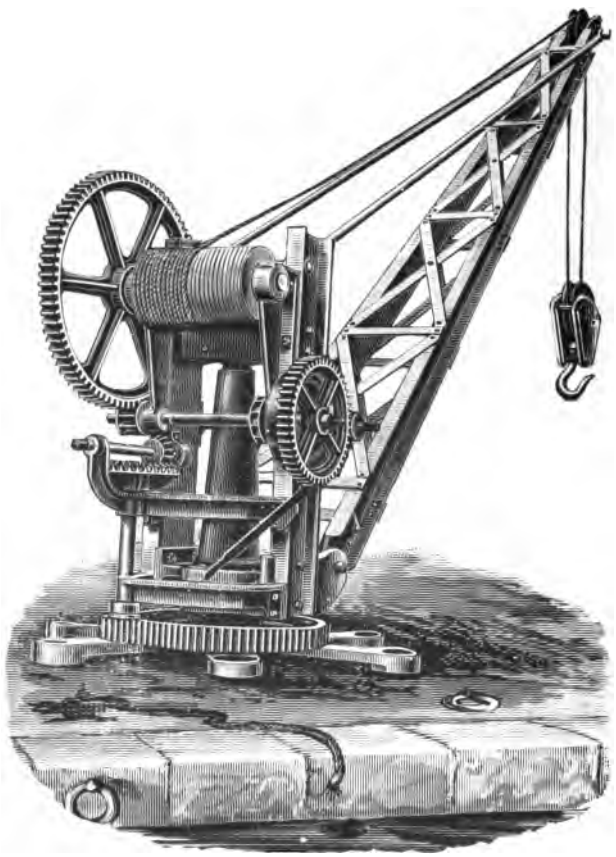


Fig. 2211

The crane post is of best hammered scrap-iron, or mild steel, and is machined to fit the base plate, the diameter being increased at this point.

The lifting gear is single and double purchase, and is provided with a brake wheel strap and lever which holds the load in any required position.

The jib is made of mild steel or timber, the former adding slightly to the cost as indicated in the subjoined list.

The slewing gear is arranged as shown in the engraving, the turning motion being transmitted by handle on the back cross shaft. It may, however, be mentioned that slewing gear is seldom required for cranes of the lighter powers.

Chain or steel wire rope.—Each crane is sent out complete with best best quality short-link crane chain, with swivel hook and ball, as shown, together with the necessary handles, and holding down bolts for foundation plate

If steel wire rope is used the proportions of the barrel and gear are increased ; the extra cost of this is about 5 per cent.

PRICES OF FIXED HAND CRANES, Fig. 2211.

Power of crane..	tons	1	2	3	4	5	8	10
Radius	feet	12	13	14	14	15	15	15
Price of crane, with steel jib..	..	£31	£38	£61	£76	£94	£133	£178
Slewing gear extra	..	£6	£8	£9	£10	£10	£14	£16
Derrick gear ,, .. .	..	£3	£4	£5	£5	£6	£8	£9
Per foot of radius extra ..	..	£2	£2	£4	£5	£7	£10	£13
Approximate weight	tons	1	1¼	2¼	3	3¾	6	8

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

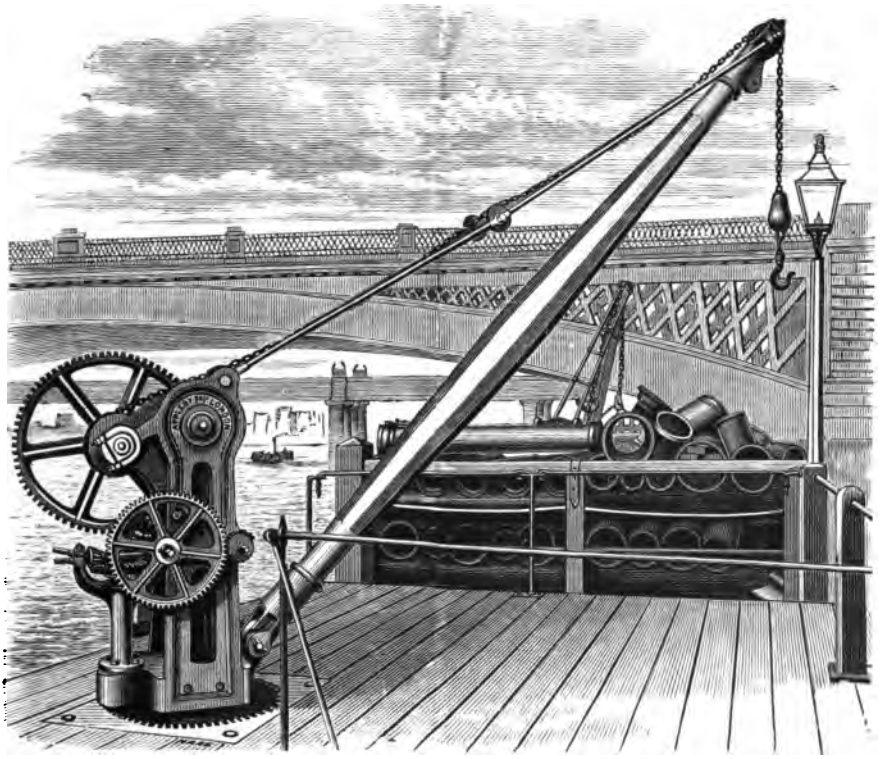


Fig. 2212.

HAND POWER WHARF CRANES.—Fig. 2212 indicates the purpose for which many cranes of this kind are used. The prices on the following page include chains, foundation plates and all accessories ready for fixing.

PRICES OF HAND POWER WHARF CRANES, Fig. 2212.

Power of crane .. .. tons	2	3	5	10
Radius of jib .. .. feet	12	14	15	18
Price of crane	£80	£90	£128	£255
Extra for steel jib	£4	£5	£8	£10
,, gun metal bushed bearings	£4	£5	£6	£8
Approximate weight .. .. tons	2¾	3½	5¼	12

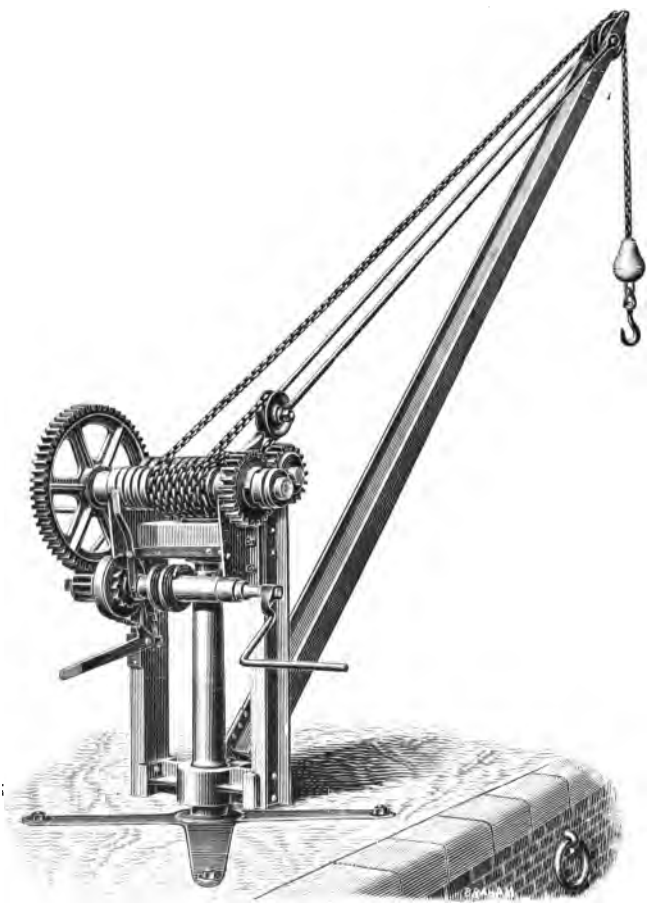


Fig. 2212a.

SHIPS DECK HAND POWER CRANE.—The superstructure is as shown in Fig. 2212 but if preferred (as it usually is) the jib is round and made of oak or pitch pine and the tie rods are arranged to be easily unshipped for stowing away on leaving port.

The prices are the same as for the cranes Fig. 2212 but if the bearings are lined with non-corrosive anti-friction metal, and chain is provided to reach 20ft. below the deck level, the extra cost is about 5%.

FIXED HAND CRANES.—Fig. 2212a represents a crane of 1 ton power and suitable for use on land or on board ship.

The jib is of mild steel of H section; the lifting gear is single and double purchase and is complete with brake and lever, pawl wheel and pawl, handles, &c.

The chain, of best best quality, reaches to ground lines and the crane is sent out with base plate and bolts for securing it to the foundation

PRICES OF FIXED WHARF CRANES, Fig. 2212A.

Power of crane .. .. tons	1	2	3	4
Radius of jib .. .. feet	12	13	14	14
Price of crane	£31	£38	£61	£76
,, slewing gear	£6	£8	£9	£10
,, derrick ,, ...	£4	£4	£5	£5

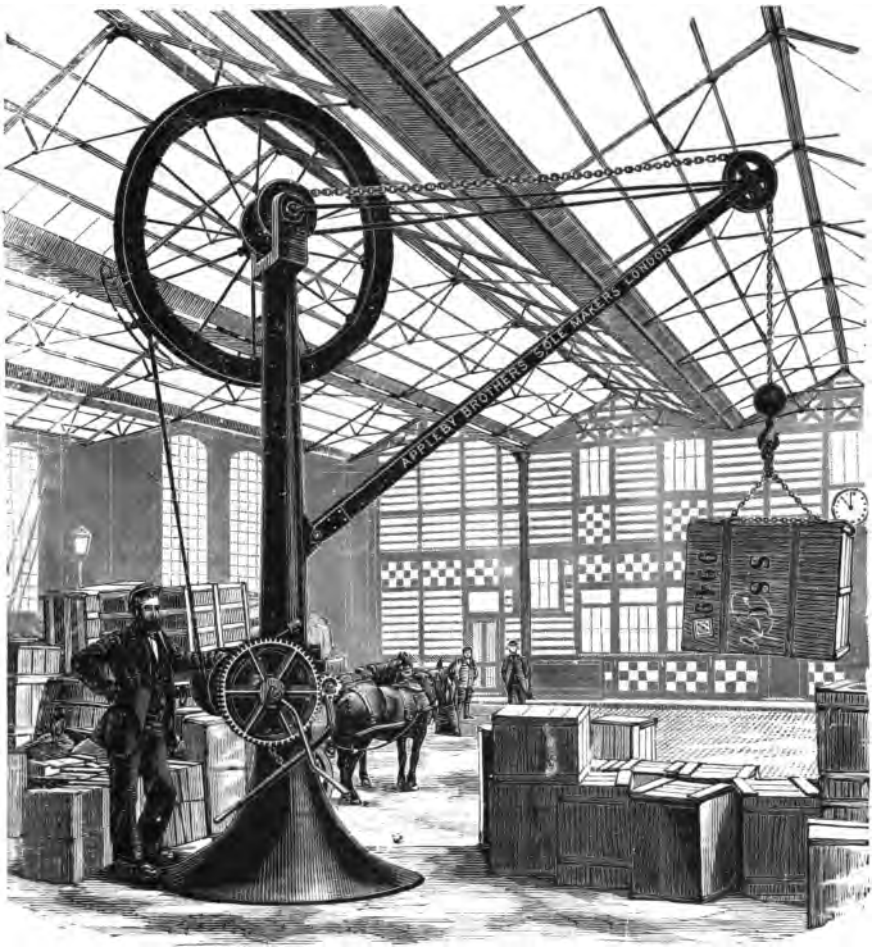


Fig. 2213.

INDEPENDENT WHIP CRANES illustrated by Fig. 2213 require no support at the top and the base covers so large an area that very little foundation is necessary. They swing completely round and the undernamed three speeds of lifting are quickly altered to suit the load to be dealt with.

The engraving is from a photograph of a portion of a railway goods station, where a number of these cranes have been in constant work for many years, and they are largely used for railway, dock, wharf and general warehouse traffic.

Construction.—A wrought iron or mild steel post is secured in the base plate casting, and the lifting gear, jib, tie rods, &c. are attached to a sleeve which rotates freely around the post; the jib describes a complete circle, and the lower end of the sleeve being provided with anti-friction rollers, the jib slews quickly and easily.

Powers and speeds.—Working loads up to about 5 cwt. are "whipped" by hauling the rope coiled on the pulley; for loads up to about one ton the handle is put on the rope barrel shaft, and for heavier loads the third purchase is obtained by transferring the handle to the pinion shaft. The crane is complete with brake and lever, lifting handles, rope, lifting chain, &c. The radius of the jib and the height within which it swings can be modified to almost any extent desired.

PRICES OF INDEPENDENT WHIP CRANES, Fig. 2213.

Power of crane	tons	1	1½	2	3
Radius of jib	feet	12	12½	13	13
Clear height of lift	,,	12	12	13	13
Price of crane complete	..	£45	£52	£60	£70
Approximate weight	tons	2	2½	3	3½

The cost of packing for shipment and delivery f.o.b is usually about 5 per cent.

Fig. 2214.

INDEPENDENT WHIP CRANES WITH STEEL SIDE FRAMES are similar in arrangement to Fig 2213 and, for that reason, are not illustrated. The gear for the three powers and speeds is as last described but a pair of steel bars of channel section is substituted for the cast iron sleeve.

The prices are rather lower than those given in the foregoing list.

WHIP CRANES WITH TOP SUPPORT, Fig. 2214.—The sides are formed of steel bars of channel section with a block and centre pin at top and bottom and footstep for the latter for fixing to the floor. The bearing for the top pin is secured to a beam, as shown, or to any other convenient attachment.

The jib swings easily through a complete circle and each crane is provided with hauling rope, best best chain, swivel hook and ball, brake and lever, pawl gear and handles.

PRICES OF WHIP CRANES, Fig. 2214.

Power of crane	tons	1	1½	2	3
Radius of jib	feet	10	11	12	12
Price of crane	..	£30	£35	£40	£55
Approximate weight	tons	1¼	1¾	2¼	3

PERMANENT WAY HAND CRANE WITH SELF-ACTING BALANCE. The crane Fig. 2215, of 5 tons power, has automatically adjusting counterweight which insures the stability of the crane when working on a line of narrow gauge, and has never failed to secure the objects for which it was designed.

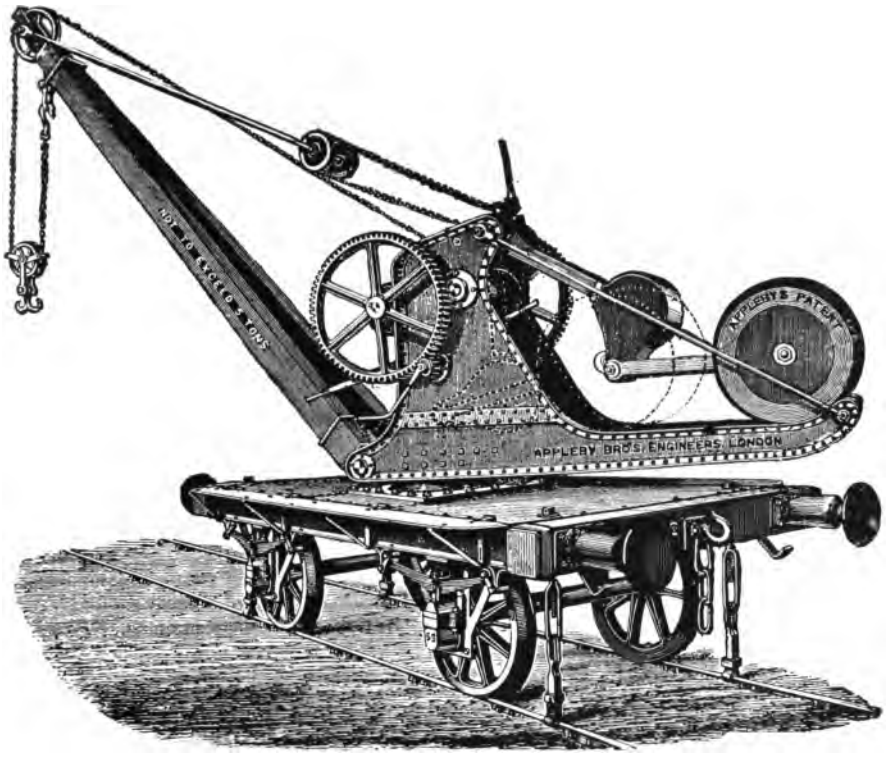


Fig. 2215.

This result is obtained by connecting the tie rods from the jib head with the cylindrical counterweight, which revolves freely and maintains a proper equilibrium by traversing to a distance from the centre post in proportion with the weight on the lifting chain.

The revolving superstructure is built of wrought iron or steel; all journals work in gun metal bearings and the pinions are in steel. The centre post is an iron or steel forging, and the crane is fitted with an anti-friction roller which bears on a turned path on the base plate. The jib is of timber or is made of wrought iron if preferred, and the crane is complete with chains, lifting block, brake and lever, handles, &c., ready for work.

The undercarriage is of wrought iron and is provided with wrought iron wheels with steel tyres, steel axles, axle boxes and guards, springs and spring blocks, buffers, draw hooks and safety chains, brakes and appliances to prevent the crane from swinging when travelling. Folding platforms afford ample space for working, and the jib is easily lowered for travelling.

PRICES OF CRANES WITH SELF-ACTING BALANCE, Fig. 2215.

Power of crane .. .. .. tons	3	5	7	10
Radius of jib .. .. .. feet	13	14	15	16
Price of crane	£325	£400	£460	£600
Approximate weight .. .. tons	11½	14½	17	22

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

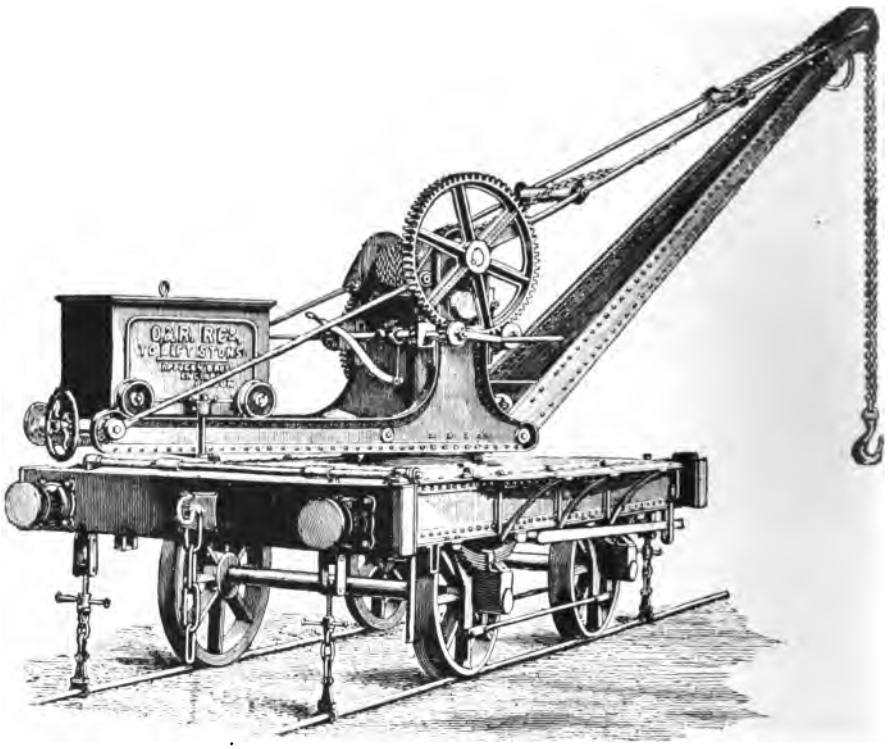


Fig. 2216.

PERMANENT WAY HAND CRANES.—Fig. 2216 illustrates a 5 tons crane of the well known type almost universally adopted for railway service, and made for all powers up to about 25 or 30 tons.

The revolving superstructure is built of wrought iron or steel, all journals work in gun metal bearings, the pinions are cast steel, and the crane post is of forged scrap iron. The jib is of steel and appliances are provided for lowering it when travelling, or it may be removed and stowed on the undercarriage.

The undercarriage is of wrought iron and is provided with wrought iron wheels with steel tyres and steel axles, springs and spring blocks, axle boxes and guards, spring buffers, draw hooks, safety chains, brake, and other accessories suitable for running with the rolling stock in use on the system for which the crane is required. A platform on each side, folded back for travelling, affords ample space for working. The position of the counterweight box is adjusted by hand wheel and screw, and the girders carrying it are firmly clamped when desired.

The materials and workmanship are of the highest class, and the proportions give large margins of safety throughout.

Prices of Permanent Way Cranes, Fig. 2216.

Power of Crane	tons	3	5	7	10	12
Radius of jib	feet	13	14	15	16	18
Price of crane	..	£290	£350	£410	£500	£560
Approximate weight	tons	9	12½	14	17	20

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

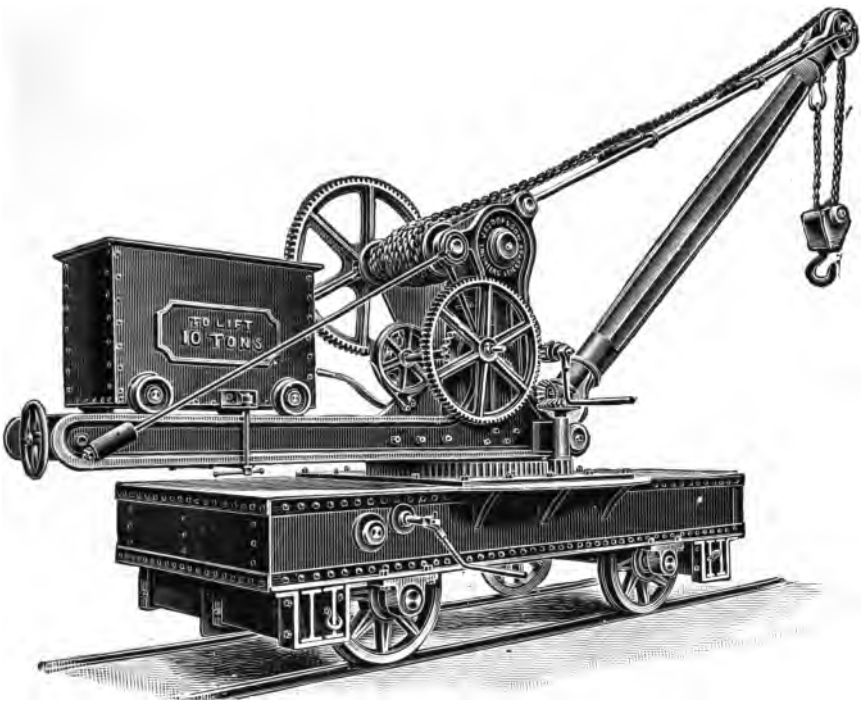


Fig. 2216A.

PORTABLE HAND-POWER CRANES FOR DOCKS, GOODS STATIONS, etc.—The proportions and finish of the cranes (Fig. 2216A) are similar to those adopted in the construction of the Permanent-way Cranes last referred to, but not being intended to run with rolling stock at ordinary main line speed they are not provided with springs, buffers, draw gear, etc. as indicated in Fig. 2216.

The revolving superstructure is of cast iron, and the crane post is of wrought iron; the counterweight box is mounted on wheels and is secured by screw clamps in the position desired. The jib is of steel or timber, usually the former.

The undercarriage is of wrought iron, and is mounted on wrought iron axles and wheels, with steel tyres. The wrought iron under girders (at each end of the carriage) are drawn out and blocked up to increase the base transversely when lifting heavy loads, but for ordinary work they remain folded within the width of the platform to admit of the crane travelling in a limited space; side platforms give the area necessary for working the crane.

A hand-power travelling motion is valuable for moving the crane short distances and for adjusting its position; the cost of this accessory is given below.

The slewing motion, shown in the engraving, saves time and labour, and ensures accurate adjustment of the jib and load; the cost of this motion is given separately.

The counterweight box, supplied with the crane, is filled with scrap iron, stones, or suitable equivalent provided by the purchasers.

PRICES OF PORTABLE HAND-POWER CRANES, Fig. 2216A.

Power of crane	tons	3	5	7	10	12
Radius of jib	feet	13	14	15	16	16
Price of crane		£160	£255	£300	£360	£420
Extra for travelling motion		£9	£11	£13	£15	£17
,, slewing ,, ...		£9	£11	£13	£15	£17
,, steel jib		£9	£11	£13	£17	£18
Approximate weight	tons	5	8½	12	15½	18

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

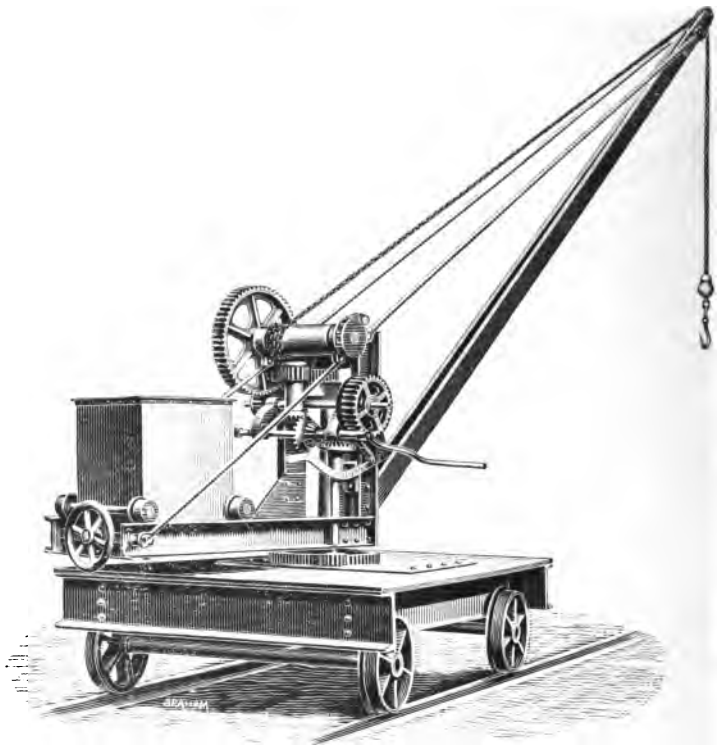


Fig. 2217.

PORTABLE HAND CRANES FOR SHOPS STORES CONTRACTORS' USE, Fig. 2217.—The cranes are constructed mainly of wrought iron or steel, and by reason of the materials employed, the weight is reduced to a minimum although the margins of safety are large.

The lifting gear is single and double purchase, and is provided with strap brake and lever.

The jib and undercarriage, as well as the frames of the revolving superstructure, are built of suitable sections of steel and the crane is mounted on flanged wheels, as shown, or on plain road wheels, as desired. In the latter case, or for narrow gauge lines, cross girders for blocking up are recommended.

Each crane is complete with box for counterweight, best tested crane chain with hook and balance ball, and the wheels and axles are adapted for 4 feet 8½ inches (1m 335) gauge, unless otherwise specified.

The slewing, derricking and travelling motions worked from the crane platform are rarely required, but they (or some of them) have been indispensable in many cases, and the separate prices for these motions and for accessories not always required, will be found below.

PRICES OF PORTABLE HAND POWER CRANES, Fig. 2217.

Power of crane	tons	1	2	3	4	5	6
Radius of jib	feet	9	9	10	10	11	12
Price of crane	..	£47	£62	£89	£107	£140	£160
Adjusting screw to balance box		£2	£2	£2	£3	£3	£3
Rail clips or under girders		£2	£2	£3	£3	£4	£4
Slewing motion		£6	£8	£9	£10	£11	£11
Derrick ,, to alter radius		£4	£4	£5	£5	£6	£7
Travelling ,, ...		£16	£17	£20	£24	£25	£27
Approximate weight		1½	2½	3½	4	5	6

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

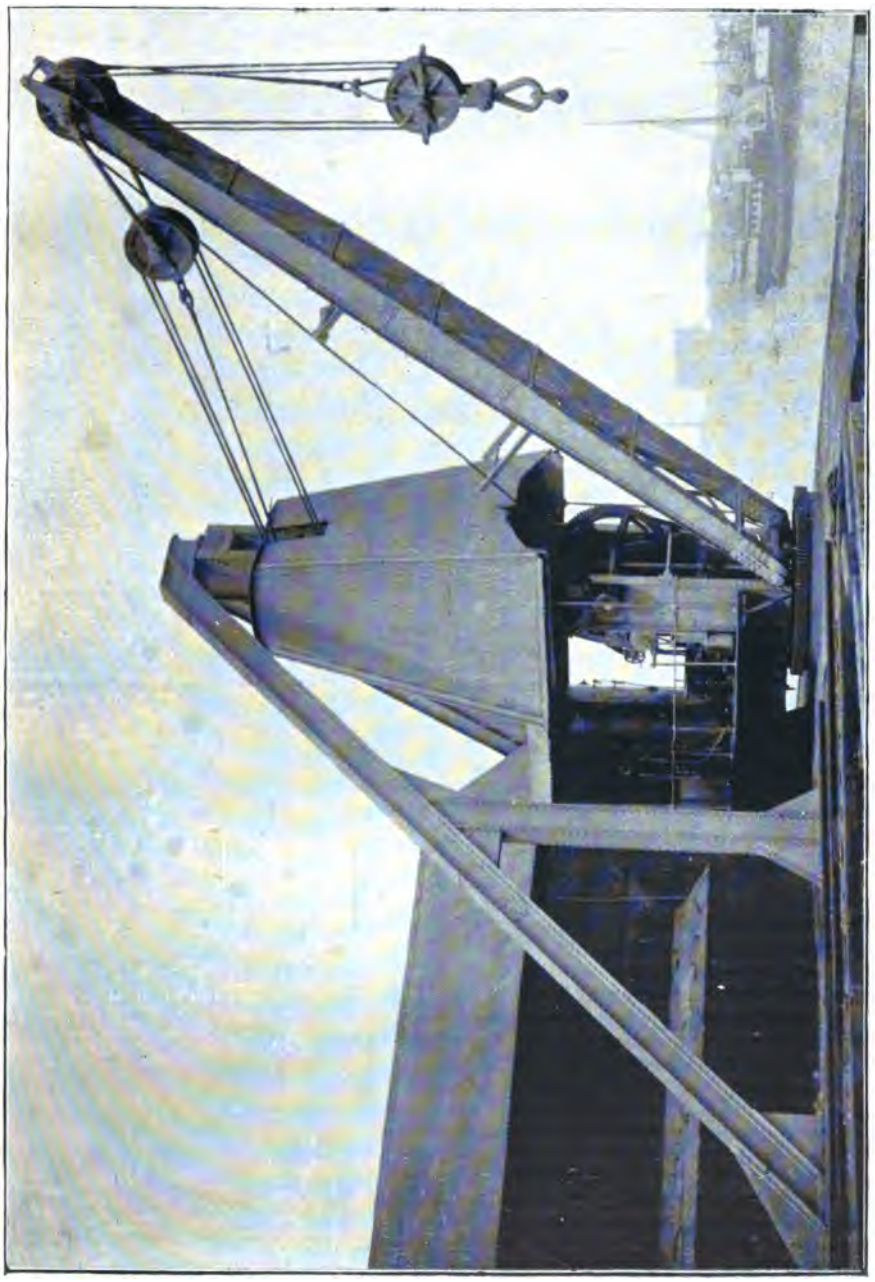


Fig. 222.

DERRICK CRANES, generally termed "safety derricks," from the fact that the chain barrel for lifting the load is (when the radius of the jib is required to be altered) geared up to a conical or "fuzee" chain barrel, to which the chains to the jib-head are attached; the proportions of this fuzee barrel and the gear are such that the strain on the derrick chain is balanced by the load on the lifting chain so that, if the lifting clutch were withdrawn, the position of the jib and load would remain unaltered.

The jib describes an arc of about 250° and the large space it commands, together with the facility with which a load is moved a considerable distance horizontally, render cranes of this construction extremely useful under widely varying conditions.

Length of jib.—This dimension may be varied to any extent desired up to about 80 to 85 feet, but a length of 50 feet is usually ample and has been adopted as a standard, for estimating purposes, for derrick cranes up to 10 tons power, worked by steam or electric motor. If the standard lengths given in the following pages must be exceeded, it may be assumed that each extra five feet in length will add about 5 per cent to the cost of the cranes.

In connection with this subject, it may be well to mention that—in most climates—timber does quite well for light work, up to a length of about 60 or 70 feet; beyond this length the jib should be built of wrought iron or steel; this construction should also be adopted for the masts and jibs, if not for the other parts, of all cranes destined for use in tropical countries.

Derrick cranes of large power.—The examples given may serve as a basis for approximate estimates of cost, but the proportions vary so widely that they should be specially considered and designed to suit local conditions, which may be exceptional.

Portable derrick cranes are identical in construction with those illustrated excepting that they are mounted on trollies which travel, by steam or hand power, along parallel lines as described further on.

Information required.—The following details should be given with reference to Derrick cranes differing in proportions from those mentioned in the following pages:—

(1) The maximum load to be dealt with at a given radius.
(2) The length of the jib—or its radius when at an angle of 45°.
(3) Whether any (or what) portions of the crane are to be in steel.
(4) Whether chain or steel wire rope is to be used.

The two last named details, however, are usually left to the discretion of the constructor of the crane.

STEAM DERRICK CRANE OF 50 TONS POWER.—Fig. 2229 represents a crane of this power which commands the centre of the hatch of the largest vessel which can be berthed alongside the quay, and the requisite area of wharf, without encroaching on space which—in this case—is very valuable. As will be seen from the engraving, part of the storage warehouse is in the angle formed by the back ties and sleepers, so that the space occupied by the crane is limited to the width of these ties and of the mast.

The mast, back ties and sleepers which are connected with the foundation plate are of steel and the proportions of these members and those of the gear for lifting, derricking and slewing, are designed to provide a factor of not less than 6 (six).

The machinery consists of a pair of engines with case hardened link motion reversing gear, and the usual fittings. The gear and shafts are of steel, the bearings in phosphor bronze, are of ample length and are carried in suitable castings which are attached to the mast.

The boiler, of the cross tube type generally used in connection with cranes, is fixed on a platform attached to the mast; this provides space for the driver to work all motions and for the storage of fuel and water.

The foundation plate is a massive casting tied to the sleepers as already described and supported on a bed of concrete. A strong central base carries a steel axis at the base of the mast and the rotating motion is transmitted by a pinion which gears into an external spur ring at the foot of the mast. A hollow central axis is provided for cranes worked by steam from a separate boiler, or by an electric motor.

The jib is built of steel. The length is about 40 feet and is strongly braced top and bottom to form a girder of box section. The rope sheaves for lifting and derricking are of large diameter and bushed with phosphor bronze; the axles for them are of steel and bored centrally for lubrication.

The ropes for lifting and derricking are of extra quality flexible steel and have a factor of safety of about 9 (nine) with the maximum load.

The block.—The frames and loop are made of Lowmoor iron and the sheaves are of the same diameter and fitted in the same manner as those in the jib. The loop is provided with a "live ring" and the maximum load is easily rotated.

The price of the crane is about .. .. £1550.

A crane of 60 tons power, of similar construction, with a jib about 60 feet long costs about .. .. £2900.

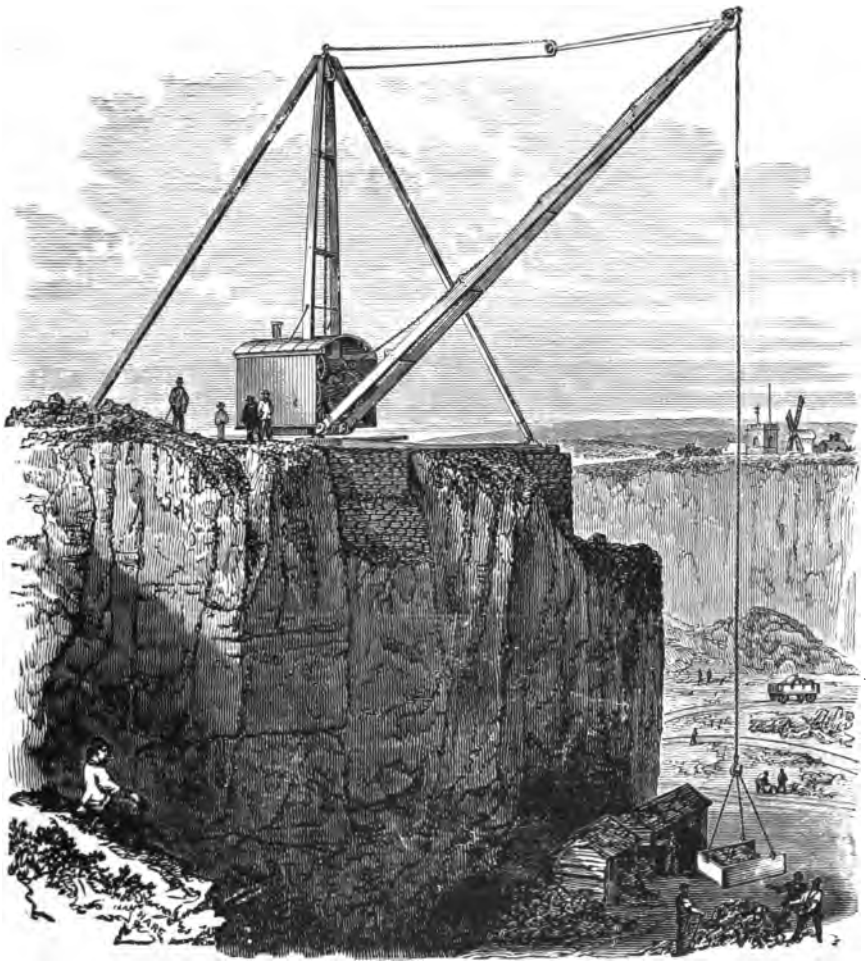


Fig. 2230.

STEAM DERRICK CRANE OF 10 TONS POWER.—Fig. 2230 illustrates a crane with a sweep of 50 feet and is typical of cranes up to that power, as usually built.

The machinery, attached to the mast, consists of a pair of engines with case hardened link motions, single and double purchase lifting gear, brake of ample power, and all appliances of the most improved type for raising or lowering the jib, with or without the load suspended. The rotating (slewing) gear, also attached to the mast, has double friction cones which transmit the turning motion—in either direction—without reversing the engines; an efficient wind brake is also provided to counteract the force of the wind and maintain the iib in any position desired.

The boiler, carried on a platform behind the mast, is of the vertical cross tube type and is complete with all furnace, steam and feed water fittings, including an injector which draws its supply from a feed water tank by the side of the boiler.

If space is exceptionally limited, the boiler is fixed on one side of the mast instead of behind it, as above mentioned.

The base plate is a massive casting which carries the steel centre pin and the spur ring around which the crane rotates, and is complete with bolts to secure it to the timber or masonry foundations.

The mast, jib, back ties and sleepers are usually made of best pitch pine.

PRICES OF STEAM DERRICK CRANES WITH BOILER, Fig. 2230.

Power of crane .. .. .. tons	1½	2	3	4	5	7	10
Length of jib	50	50	50	50	50	50	50
Price of crane with chain	£156	£188	£213	£247	£320	£400	£530
,, ,, with steel wire rope .	£164	£196	£222	£256	£330	£410	£542
,, lagging boiler	£12	£13	£13	£14	£15	£15	£17
,, galvanized iron canopy ..	£7	£8	£9	£10	£10	£12	£14
Approximate weight .. .. tons	5¾	6¾	8¼	10¼	12½	15½	19½

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

STEAM DERRICK CRANE WITHOUT BOILER.—If the steam supply is taken from a separate boiler, the centre pin is bored and fitted with a swivelling connection for conveying steam to the cylinders. In other respects the construction and the cost of accessories, packing, &c., are the same as indicated in the description of cranes Fig. 2230.

PRICES OF STEAM DERRICK CRANES WITHOUT BOILER.

Power of crane tons	1½	2	3	4	5	7	10
Length of jib .. feet	50	50	50	50	50	50	50
Price of crane	£140	£173	£195	£230	£290	£380	£508

MACHINERY AND IRONWORK FOR STEAM DERRICK CRANES.—This usually comprises the mast with engines, gear, &c., fitted to it, as referred to in the description of Fig. 2230, also the top and bottom pins and base plate for securing to the foundations, the lifting and derricking chains or ropes, jib shoes and head piece with pulley, derrick chain sheave and connection, boiler and fittings, wrought iron straps and accessories to connect the mast with the back ties, and the necessary bolts, plates, &c.

This leaves only the timber in the jib, back ties and sleepers, to be made by the purchaser and—if desired—the drawings for these parts can be obtained at a nominal cost.

PRICES OF MAST WITH MACHINERY AND IRONWORK FOR STEAM DERRICK CRANES.

Power of crane .. .. tons	1½	2	3	5	7	10
Length of jib .. .. feet	50	50	50	50	50	50
Price of Machinery, &c. ..	£120	£145	£165	£240	£310	£410

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

STEAM DERRICK CRANES WITH STEEL MAST AND JIB—The conditions under which it is advisable to adopt this construction are referred to at page 83 and to those may be added, the small resistance to wind pressure presented by the steel lattice braced jib.

The cranes are complete with steel mast, machinery and boiler, and the back ties and sleepers are of timber; for description of the mechanical details, prices of accessories, &c., see those relating to Fig. 2230.

PRICES OF STEAM DERRICK CRANE WITH STEEL MAST AND JIB.

Power of crane..	tons	1½	2	3	4	5	7	10
Length of jib	feet	50	50	50	50	50	50	50
Price of crane with chain		£190	£207	£236	£287	£384	£480	£636
,, steel wire rope		£198	£215	£245	£296	£394	£490	£648
Extra per 5 feet length of jib ..		£10	£11	£13	£15	£19	£23	£30
Approximate weight	tons	6½	7½	9	11	13½	16½	21

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

STEEL MAST, MACHINERY AND IRONWORK FOR STEAM DERRICK CRANES.—The mast is fitted with machinery precisely the same as that last referred to, and the following prices include the boiler, platform, all ironwork and materials for the complete crane, excepting the wood work in jib, back ties and sleepers.

This arrangement reduces the cost of transport and, for some climates, a steel mast is preferable to one of timber.

PRICES OF STEEL MAST, MACHINERY, &C. FOR DERRICK CRANES.

Power of crane..	tons	1½	2	3	4	5	7	10
Length of jib	feet	50	50	50	50	50	50	50
Price of mast, machinery, &c. ..		£150	£180	£205	£235	£295	£380	£500

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

HYDRAULIC DERRICK CRANES.—The engravings Fig. 2229 and 2230 and the descriptions relating to them, apply equally to cranes worked by hydraulic power so far as general construction and arrangement is concerned.

A hydraulic motor takes the place of the steam engine and boiler and the central pivot, which supports the mast, is hollow and has an internal diameter requisite for carrying the pipe connection with the pressure main and the waste water to the exhaust main.

The motions for lifting, lowering, slewing and derricking can be used in any combination and the levers controlling them are conveniently arranged.

If vibration must be reduced to a minimum, hydraulic rams and cylinders are substituted for the motor last named. This construction was very perfectly carried out in the special cranes used in the erection of the Forth Bridge.

The cost of hydraulic derrick cranes is approximately the same as that of electric cranes, the prices of which will be found at page 90.

"GUY" CRANES.—Hand power cranes of the type indicated in Fig. 2231 were used in quarries, stone yards, &c., long before the "Safety Derrick Crane," illustrated by Figs. 2232 and 2236 was invented. But the Guy crane furnished the late Mr. Henderson (to whom we are indebted for this admirable invention) with the basis for the general construction of the now well known, "Henderson's patent safety derrick."

The crane illustrated is of 10 tons power and several of them were used (in the first instance) in the construction of important docks After completion of the work the cranes were taken over for permanent service for quay and railway goods traffic.

The descriptions of the steam derrick crane Fig. 2230 and of the hand power crane Fig. 2236 apply equally to that now referred to, excepting that rigid ties between the mast and the jib head are substituted for the derricking gear, whereby the radius is altered, if desired, simultaneously with the lifting and slewing motions, or either of them.

PRICES OF STEAM "GUY" CRANES, Fig. 2231.

Power of crane	tons	2	3	4	5	7	10
Radius of jib	feet	40	40	40	40	40	40
Price of crane	..	£175	£200	£235	£310	£375	£510

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

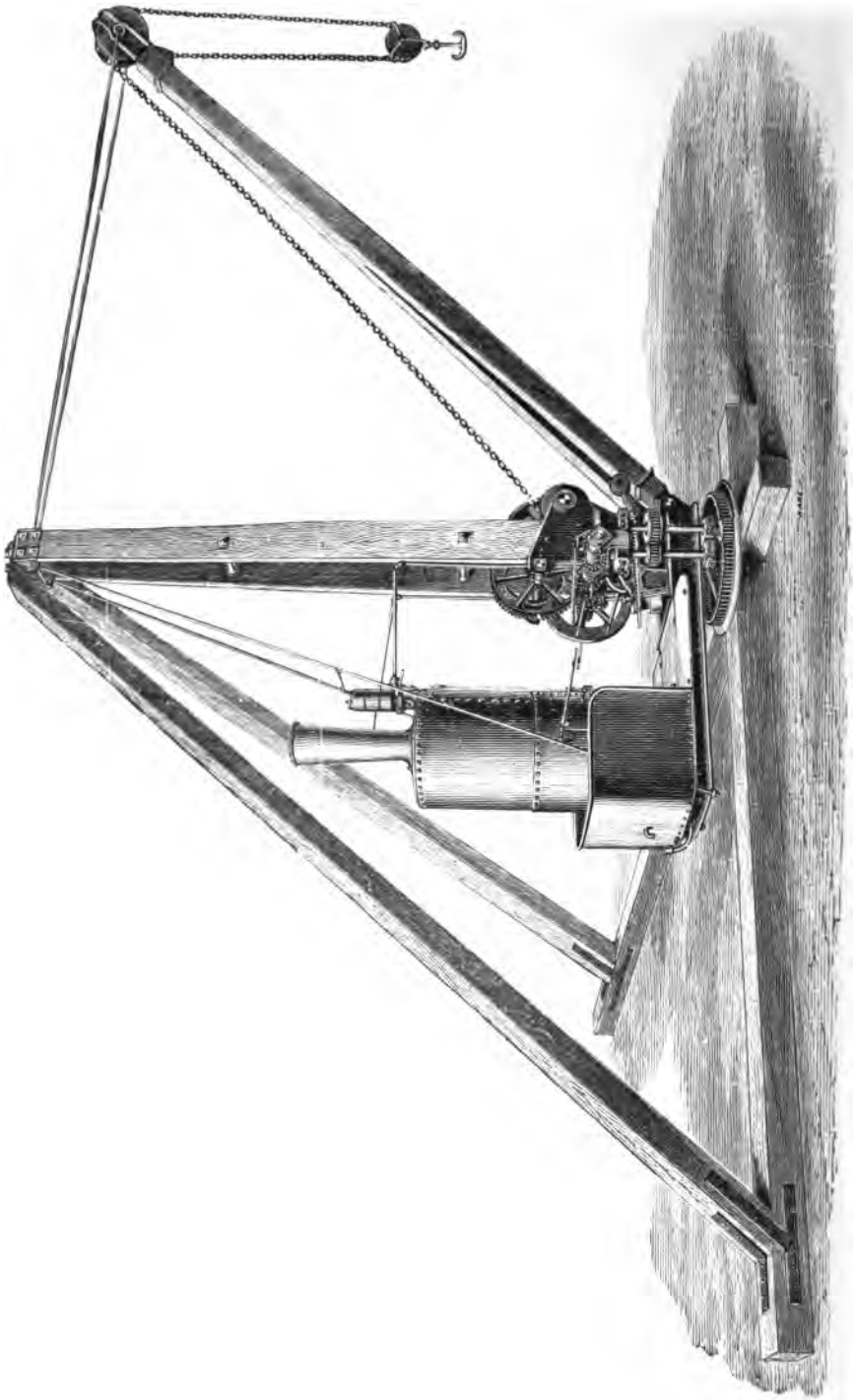


Fig. 2231.

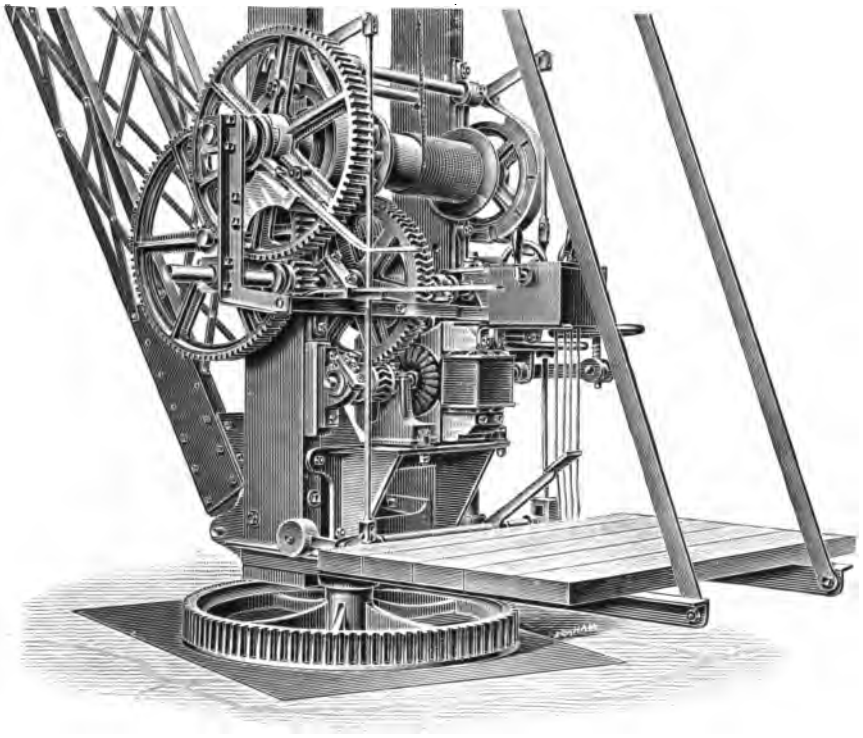


Fig. 2232.

ELECTRIC DERRICK CRANES.—The arrangement of machinery is practically the same as that so successfully employed in steam derrick cranes as shown in Fig. 2232, excepting that an electric motor is substituted for an engine and boiler as the motive power.

The advantages derived from the use of this system are referred to at page 68, and to these may be added the facility for taking power, for any number of cranes, from an ordinary supply main or from the special installation with which large buildings and works are now so frequently provided. Attention may also be directed to the absence of risk from fire and the consequent reduction in the cost of insurance.

The motor is fixed near to the base of the crane and has a large margin of power beyond that requisite for the maximum duty specified. The power is transmitted by double friction cones which reverse the direction of motion in lifting, slewing, &c., and can be used in any combination without reversing the rotation of the motor.

The machinery.—As already indicated, this so closely resembles that used for steam derrick cranes Fig. 2230, that the description of it need not be repeated. The switches and levers are conveniently arranged and the several motions are under complete control.

Speeds.—The proportions of the motors suffice for lifting the average load at a speed of 30 to 40 feet per minute and proportionately higher speeds for lighter loads. If these speeds must be exceeded the cost of the crane is slightly increased, but they are usually ample.

Consumption of power.—The power consumed is in direct proportion with the work performed and ceases absolutely so soon as the crane ceases to work.

For notes on "length of jib," "information required," and for prices of accessories, see page 83.

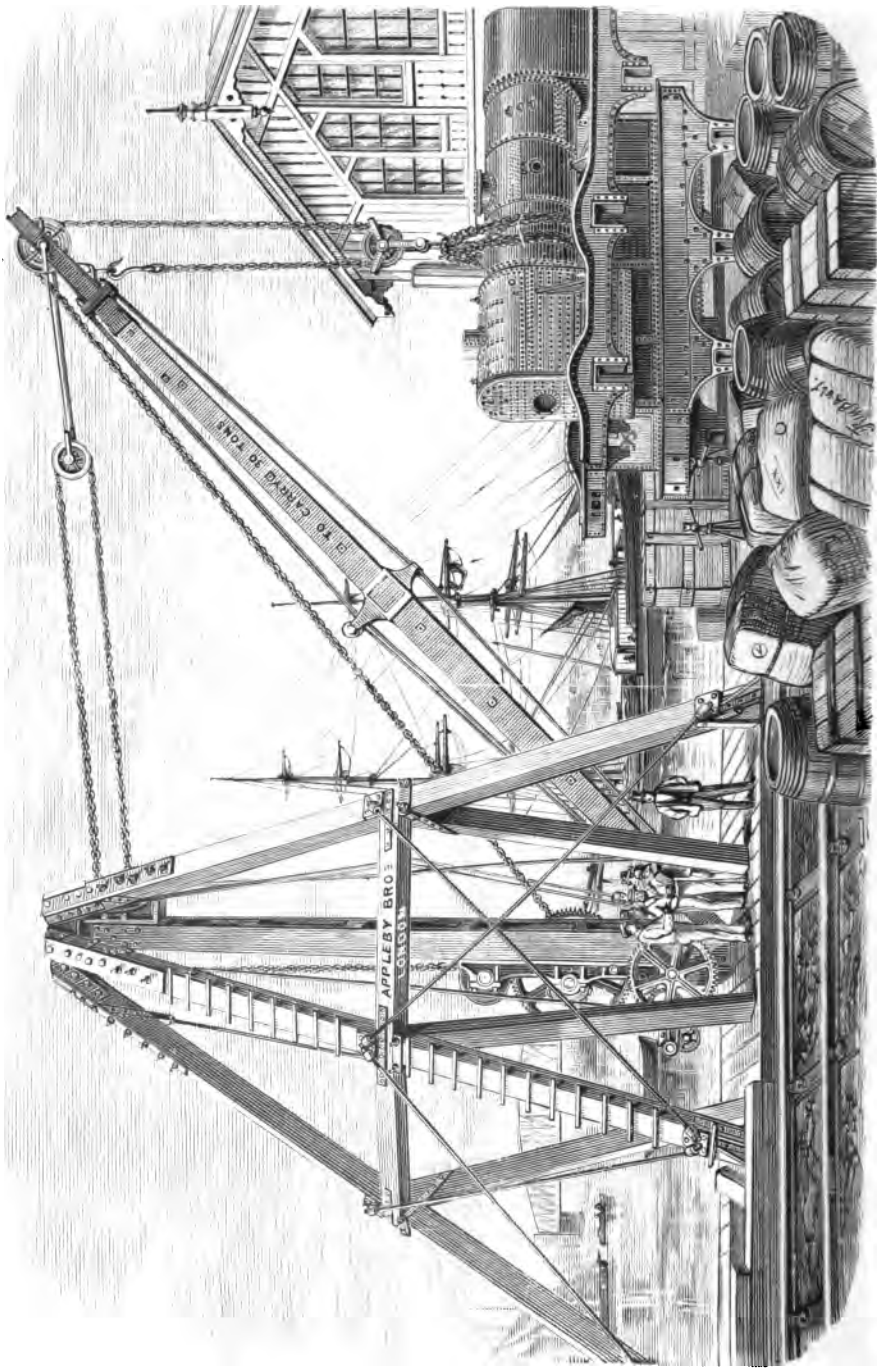


Fig. 2234A

PRICES OF ELECTRIC DERRICK CRANES. Fig. 2232.

Maximum power ..	tons	1½	2	3	4	5	7	10
Length of jib	feet	50	50	50	50	50	50	50
Price of crane in timber ..		£184	£226	£268	£310	£385	£465	£570
,, ,, iron jib ..		£194	£238	£282	£326	£405	£490	£600
,, house		£14	£15	£16	£18	£20	£23	£25
Approximate weight ..	tons	6	7	8	10	12	14	16

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

PORTABLE DERRICK CRANES to work by **steam, electric** or **hand power,** are not illustrated because they are precisely similar to Figs. 2229 to 2236, excepting that they are mounted on three strong trollies, one carrying the foundation plate under the mast, and one under the outer end of each back tie and sleeper. The wheels for the trollies are arranged for 4 ft. 8½ in., or other approved gauge, and travel on parallel lines by steam or manual power; the latter usually answers every purpose.

The prices of these cranes cannot be accurately defined without the details referred to at page 83, under the heading "information required" but, for approximate estimate, it may be assumed that a portable derrick crane will cost about 20 per cent. more than a fixed derrick crane of equal proportions.

HAND POWER DERRICK CRANE OF SPECIAL CONSTRUCTION.—Fig. 2232A is an example of a crane of 50 tons power which was specially designed to distribute the strains, as far as possible, over the foundations which were of doubtful stability; although these were designed and put in, with great care, under the direction of the Engineer-in-chief, the test with the maximum load indicated that the foundations were not even then sufficiently goodand it was necessary for that reason to limit the working load to 30 tons; since this has been done no inconvenience has been experienced.

The proportions of gear are arranged for four men on each side to work the crane with its maximum load when exerting about 30 lbs. on the handles.

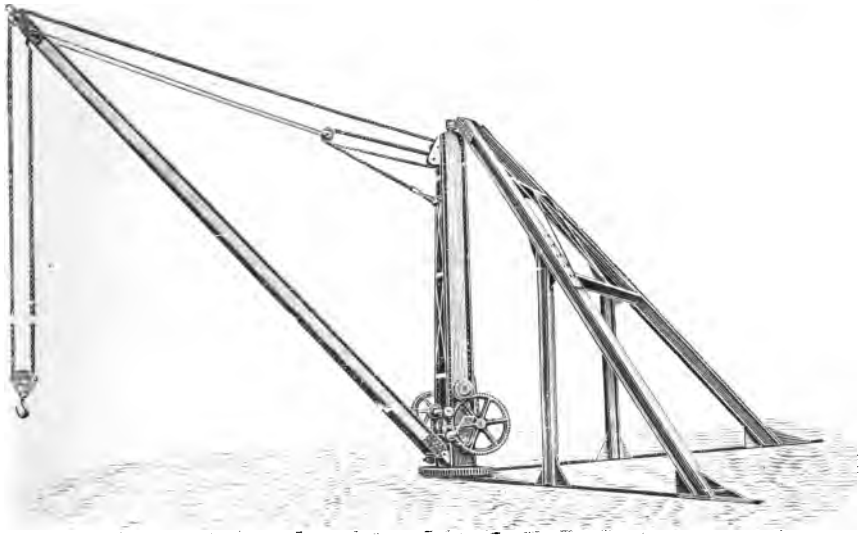


Fig. 2233.

HAND POWER DERRICK CRANES CONSTRUCTED OF STEEL.—Fig. 2233 illustrates one of a number of cranes of 10 tons power built for Her Majesty's Government for use in tropical countries where timber is rapidly destroyed by white ants. A more usual arrangement is to send the mast and jib in steel complete with all machinery and accessories, including the attachments to the pin at the top of the mast, leaving the back ties and sleepers to be made in timber from drawings supplied with the crane.

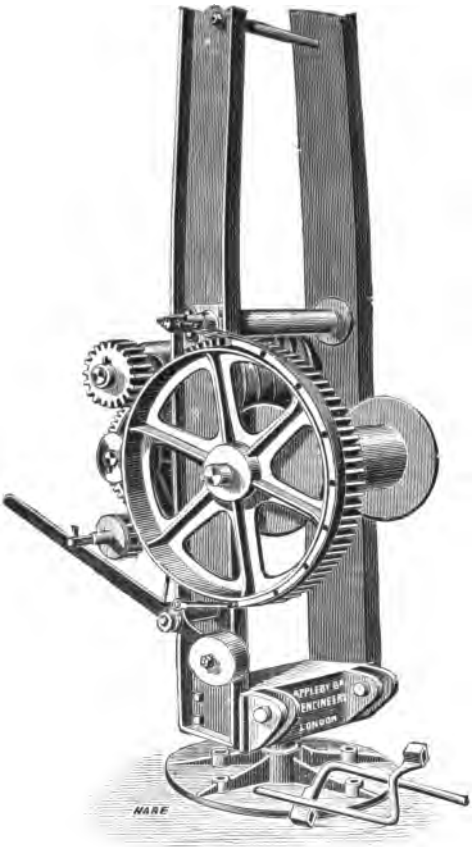


Fig. 2234.

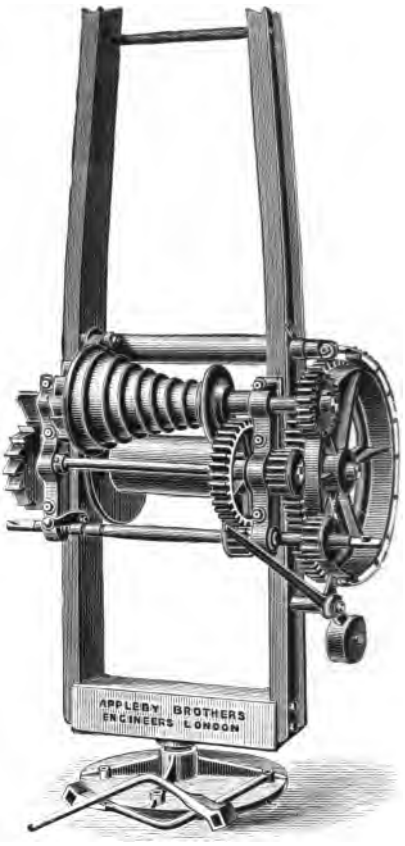


Fig. 2235.

HAND POWER DERRICK CRANES WITH STEEL MAST AND JIB.—The cranes Figs. 2234 and 2235 are of 3 and 5 tons power and are usually built with back ties and sleepers in timber, these are included in the subjoined prices. The same arrangement of gear is adopted for cranes of all powers; the proportions are ample throughout, and a slewing motion worked from the crane (not shown in the engraving) is provided where necessary.

The machinery attached to the mast consists of single and double purchase gear, strap brake, safety catch for jib, derricking gear and (when required) the appliances for slewing. The chains for lifting and derricking are of best best quality and are complete with all accessories.

Flexible steel wire rope is substituted for chain at an extra cost of about 5 per cent.

PRICES OF HAND POWER DERRICK CRANES, Figs. 2234 and 2235.

Power of crane..	tons	1	2	3	5	7	10	15
Length of jib	feet	35	40	40	40	40	40	40
Maximum radius	,,	25	30	32	32	32	32	32
Price of crane	..	£42	£68	£86	£120	£166	£218	£283
Extra per 5 ft. length of jib ..	..	£2	£3	£5	£6	£8	£10	£14
Approximate weights	tons	2½	3	4	6	7¾	13	15½

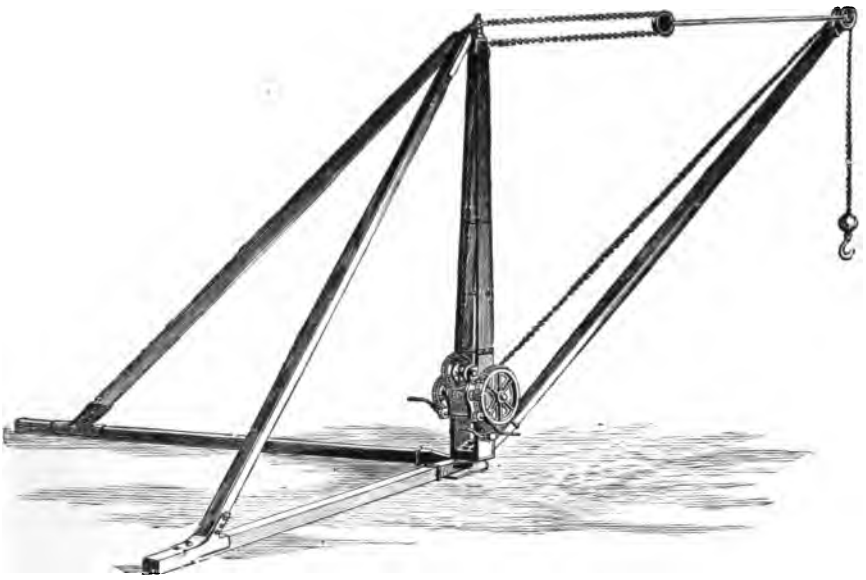


Fig. 2236.

HAND POWER DERRICK CRANES, CONSTRUCTED OF TIMBER.—The well known type of derrick crane in general use, represented in Fig. 2236, consists of mast, jib, back ties and sleepers in pitch pine or other suitable timber.

For large powers the mast is cross-braced and revolves on a strong steel pin secured in the foundation plate and supported at the top by a similar pin; strong wrought iron straps are attached to the back legs, and the lower ends are tied to sleepers extending from the foundation plate.

The machinery is fixed to the mast and consists of single and double purchase gear for lifting and derricking, strap brake, safety catch for jib, best tested crane chain to foundation level with swivel hook, derricking chains, handles and all accessories ready for work, and each crane is tested with the maximum load before delivery.

HAND POWER DERRICK CRANES, Fig. 2236.

Power of crane ..	tons	1	2	3	5	7	10	15
Length of jib	feet	35	40	40	40	40	40	40
Maximum radius ..	,,	25	30	32	32	32	32	32
Price of crane		£32	£54	£70	£96	£132	£175	£230
Extra per 5 feet length of jib		£2	£3	£4	£5	£7	£9	£12
Approximate weight ..	tons	2¼	2¾	3½	5½	7	12	14½

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

MACHINERY AND IRONWORK ONLY FOR DERRICK CRANES, Fig. 2236.—This comprises the whole of the gear last mentioned and the ironwork for the head and base of mast, foundation plate, jib shoe, head piece with pulley for lifting chain, rods, pulley and chain for the derrick motion and the straps, knees, bolts, &c. for fixing to the timber work.

PRICES FOR MACHINERY AND IRONWORK FOR DERRICK CRANES, Fig. 2236.

Power of crane	tons	1	2	3	5	7	10	15
Length of jib	feet	35	40	40	40	40	40	40
Price of machinery		£27	£42	£55	£75	£104	£137	£176

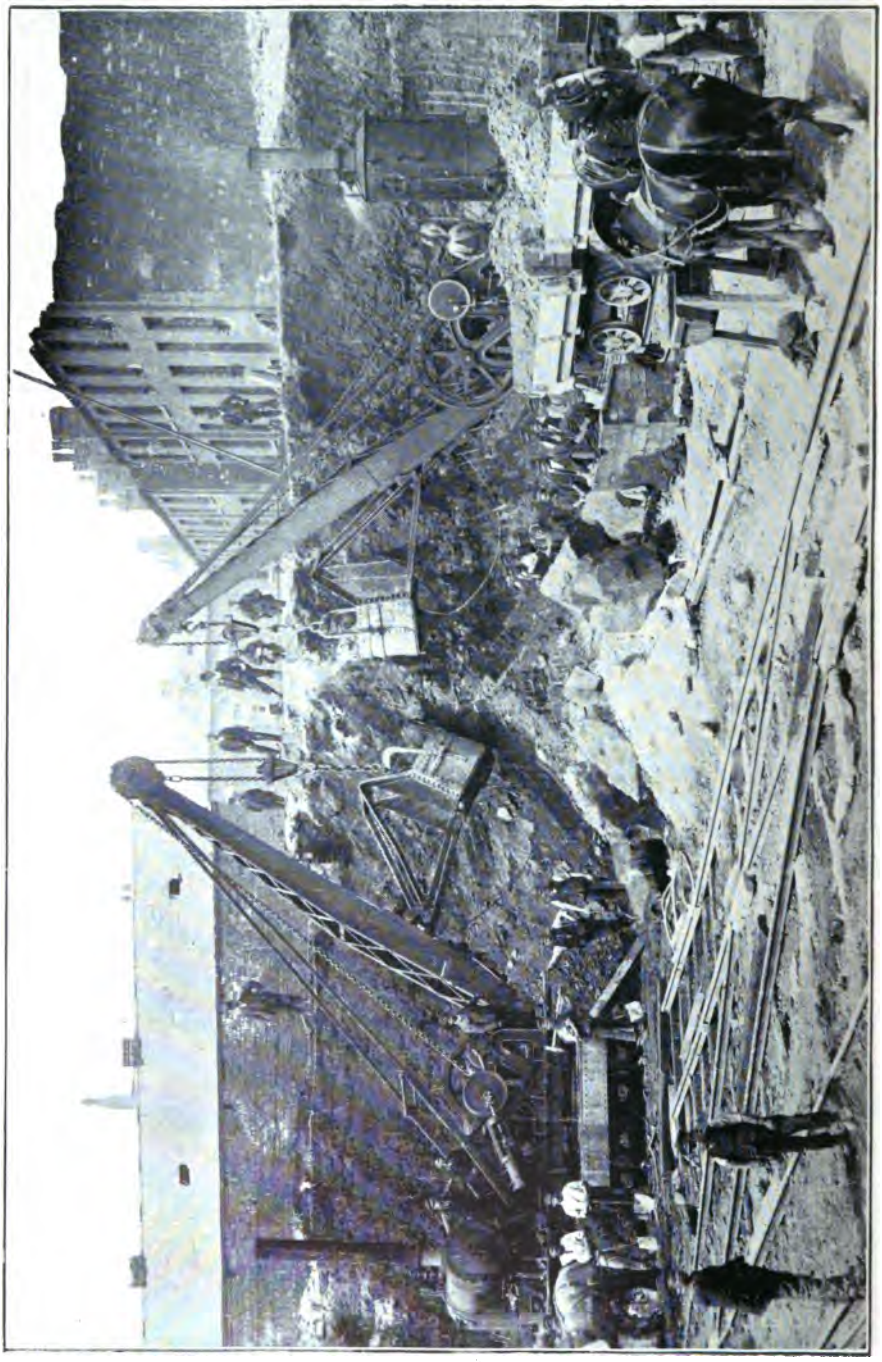


Fig. 2236A

STEAM EXCAVATORS.—Several mechanical arrangements have been devised for excavating sand, clay, marl and soft rock and depositing the "spoil" in trucks for removal. Others deliver the excavated materials on a carrier which deposits them at varying distances, to form an embankment or otherwise dispose of them. The machine now illustrated is available for a far wider range of work than any other type of excavator, and being essentially a steam crane with detachable appliances for excavating, should find a place in this Section.

Locomotive steam crane excavators of the type Fig. 2236A. The jib and counterweight make a complete revolution, in either direction, and the machine will either excavate or deposit at any part of the circle described by the jib.

End on steam excavators with excavating bucket similar to Fig. 2236A, have the machinery, boiler, &c., forming the counterweight, fixed on the undercarriage, the jib only moving through an arc limited to about 90° for excavation and deposits.

Side steam excavators, with dredger buckets and ladder, which travel on rails parallel with the excavation and are capable of working at a considerable depth below rail level, the position of the bucket ladder being adjustable to work at almost any angle, the banks of a river or canal are formed to the slope desired.

All these machines have been extensively and profitably used under the conditions for which each type is specially adapted, and will be referred to in detail in Section V.

LOCOMOTIVE STEAM CRANE EXCAVATORS are an adaptation of the well known steam crane, and are used as such when the excavating appliances have been removed—the alteration being the work of a few minutes. The cranes in general use for this purpose are of 5, 7 and 10 tons power. Three tons crane excavators have been made, but the larger sizes are found to be more economical and durable.

The output in stuff excavated and deposited in trucks naturally varies with the strata in which the machine works, but that from a 10 ton machine is usually from 500 to 1,000 cubic yards per day.

A 7 tons machine will give 400 to 800, and a 5 tons from 300 to 700 cubic yards per day.

The railway cutting illustrated by Fig. 2236A consisted of a rather loose and (when excavated) not very hard rock, but sufficiently so to leave the "cleaning up" marks made by the steel teeth of the bucket, seen on the side of the cutting to the right of the engraving.

The machine consists of a strongly constructed steam crane with motions for travelling and for altering the radius of the jib by steam power.

The excavating bucket is attached to the jib by compensating gear which is controlled by the steam cylinder as indicated in the engraving. This gear holds the bucket up to its work and shortens the radius through which it travels; it also enables the bucket to clear all obstacles arising from falling stones or soil.

The machinery and boiler, which form counterweight, revolve with the jib and maintain the stability of the crane at whatever angle, relatively with the crane track, it may be working—a matter of great importance on soft or imperfect crane tracks—as these usually are.

The excavator cuts its own "gullet" and, the radius of the jib being adjustable, it can be set at the angle most favourable for the work, this frequently admits of the machine doing work which must otherwise be done by manual labour. No other machine possesses this facility.

The 5 and 7 tons machines are usually provided with buckets of 1 cubic yard capacity and the 10 tons with 1½ yard buckets.

The working expenses necessarily vary with the nature of the ground, the prices of labour, fuel, etc. but, including the cost of driving the excavator, manipulating trucks around the machine, filling them, superintendence, etc., the cost will rarely exceed 1½ to 2 pence per cubic yard.

APPROXIMATE PRICES OF STEAM CRANE EXCAVATORS, Fig. 2236A.

Power of crane .. .. tons	5	7	10
Price of excavator	£915	£1045	£1186
Ditto for ditching	£945	£1070	£1228
Approximate weight	18½	23	32
Ditto measurement	1508	1770	2300

The cost of packing for shipment and delivery f.o.b. varies from 3 to 5 per cent.

ACCESSORIES FOR CRANES.

The labour saving appliances referred to in the following pages greatly increase the earning power of most kinds of lifting machinery in connection with which they are used, and the illustrations and descriptions—together with those relating to cranes—furnish the information necessary for determining the type of plant best adapted for quickly, and economically executing most kinds of work.

Modifications in dimensions (or even special designs) may sometimes be necessary, but one or other of the standard types now referred to, will be found to suffice for all usual demands.

GRAB DREDGERS AND BUCKETS.—All the grabs Figs. 2237 to 2248 are worked by a single chain or steel wire rope and can be used in connection with steam, hydraulic or electric cranes. This entirely dispenses with the inconvenience of a special crane with separate chains, chain barrels, levers, &c. respectively for lifting and opening, which were essential for the earlier forms of grabs. They are completely automatic in filling and emptying and the closing arms are so arranged that when the jaws (descending as shown in the engravings) have entered the material to be removed, they unlock and the crane being then reversed in the lifting gear, they are forced further into it by the lifting chain becoming taut and so the bucket is filled. The grabs Figs 2243 to 2247 (Hone's patent) have adjustments whereby the penetrating power is increased in a few seconds from 2 to 1 to 4 to 1, which materially aids in ensuring the bucket being filled at each operation. All the grabs now referred to are made of steel throughout, of the sections requisite for sustaining the strains incidental to the work for which each kind has been designed.

Work performed.—This necessarily varies in proportion with the size of the grab, the efficiency of the crane and driver, the height of lift and the facilities for clearing away the materials lifted. But the following quantities per hour are easily dealt with by cranes and grabs of the most improved types.

Coal	30 to 100 tons per hour.
Chalk, shingle, &c.	30 to 60 ,, ,,
Mud, small coal, &c.	50 to 100 ,, ,,
Clay	30 to 80 ,, ,,
Grain and seeds	200 to 350 quarters ,,

These are only a few of the materials moved by grabs, but the foregoing figures furnish a basis for estimating the duty obtainable when working materials differing from those mentioned.

The quantities given in the following tables differ from those given above and may be regarded as a low average when working with ordinary cranes, under ordinary conditions.

Economy in time.—The information given in the remarks on "discharging barges and sea going vessels" shows that the saving in time—compared with the ordinary system of working—is very large. Local conditions must evidently affect the **extent** of the saving, but a basis for estimating this is afforded by the fact that one crane and grab, worked by a driver and two labourers, frequently discharges 600 to 700 tons of coal in a day of 10 hours, and even more under favourable circumstances.

Economy in working expenses—The saving in this important item is even more remarkable. Millions of tons of some of the materials above mentioned are annually removed by grabs of the types referred to, at a cost not exceeding one penny per ton. The cost of the same work by manual labour is 5 pence to 6 pence per ton.

The cost of maintenance is very low, and a scarcely less important consideration is the certainty that vessels, barges, or trucks will be discharged in a given number of hours, ready for further service.

Breakage of coal, coke, &c.—Contrary to the opinion generally entertained, the waste in dust (breeze) is quite 60 per cent less when it is discharged by a properly designed grab, than when it is discharged by hand.

This is due to the fact that only a small portion of the shell of the grab—which lifts (say) 1 ton at each operation—comes into contact with the materials. The disintegration is, therefore, very much less than that caused firstly by loosening the coal ready for shovelling, and afterwards in charging into skips.

Discharging barges or sea going vessels.—Probably no installation of machinery so quickly yields a large return on the outlay as well arranged plant for this purpose, the saving in the cost of handling being frequently at least 4 pence per ton, with a large economy in time, as indicated in the preceding paragraphs.

Coal, coke, chalk, clay, &c.—Enormous quantities are daily discharged by this system, and many facilities have been devised for transferring the materials to the points where they are to be used.

If a light narrow gauge railway with turn-over trucks does not suffice, it is a mere matter of convenience whether the hoppers or carriers shall be fixed or portable. An existing hopper may be utilised if the crane is fixed to reach it, but if it is portable, a hopper may form part of a travelling staging which carries the lifting machinery.

Conveyors.—If the large area covered by the sweep of the crane jib is insufficient, the coal or other material is deposited on a specially designed endless band—or some other form of carrier—which conveys and distributes it at any point desired in the length of traverse.

The cost of a portable steam crane and grab similar to many in constant use, which discharge 60 to 80 tons of coal per hour, is about .. .. £560.

Grain, seeds, sand, &c.—The form of skip best adapted for these, differs to some extent from that generally used for coal and coke, the mode of working and the economical results are, however (practically) as above described.

Fig 2237.

Fig. 2238.

HALF TINE GRABS (Musker & Vaughan's patent).—Fig 2237 represents the grab closed, as when lifted, and Fig. 2238 as it appears. ready to descend, after the load has been discharged and the head disengaged from the opening crown.

Grabs of this type are suitable for excavating clay, ballast or other tenacious matter, for clearing the floors of docks, deepening rivers, canals or other water ways, removing weeds and foreign matter, excavating in caissons, coffer dams, &c.

Whole tine grabs are similar to those illustrated, excepting that they are without the plates which form the shell, the sections of the tines being proportionately increased.

These grabs are used with advantage for lifting stones, boulders, pieces of timber and—generally—where there is little or no mud or small stuff.

PRICES OF HALF AND WHOLE TINE GRABS, Figs. 2237 and 2238.

Capacity in cubic yards	½	¾	¾	1	1½
Price of grab	£78	£86	£100	£122	£165
Gear for opening at varying heights ..	£8	£10	£12	£15	£20
Approximate quantity raised per hour, tons	12	15	25	35	50
Power of crane required .. .. ,,	2	3	5	7	10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Fig. 2239.

Fig 2240.

OUTSIDE TINE GRABS, Fig. 2239, are made entirely of steel, and being intended for working in looser materials than those last referred to, such as coal and coke, hard sand and some gravels and marls, the tines are secured to the outside of the bucket for the purpose of loosening the ground or material to be lifted and filling the grab at each operation.

PRICES OF OUTSIDE TINE GRABS, Fig 2239 and 2240.

Capacity in cubic yards	½	¾	¾	1	1½
Price of grab	£66	£73	£86	£107	£145
Gear for opening at varying heights ..	£8	£10	£12	£15	£20
Approximate quantity raised per hour, tons	13	20	30	40	60
Power of crane required .. .. ,,	2	3	5	7	10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Fig. 2241

Fig. 2242

BUCKET GRABS of this type are made of mild steel plates strengthened by frames as shown and are specially adapted for transferring grain, seeds, sand, &c., from truck or floating craft to store, or for any combination of these operations. They are also used with great advantage for lifting and depositing silt, grout, puddle and slurry, and for dredging mud.

Grab for irregular strata.—It is sometimes desirable to have a set of light steel tines which can, at any time, be bolted to the shell of the bucket and so adapt it for working satisfactorily, even in the comparatively hard ground which is frequently met with in sedimentary deposits

These tines are removed or fixed in a few minutes and—at the small extra cost indicated below—the best provision is made for working continuously under almost any conditions.

Crane power.—To ensure the maximum output with the lowest working expenses it is essential that the lifting power should be ample and the speeds throughout equal to at least 60 complete operations per hour.

PRICES OF BUCKET GRABS, Fig. 2241 and 2242.

Capacity in cubic yards	⅓	½	¾	1	1½
Price of grab	£56	£63	£72	£95	£130
Gear for opening at varying heights ..	£8	£10	£12	£15	£20
Outside removable tines extra	£9	£11	£14	£15	£16
Approximate quantity raised per hour, tons	17	25	35	50	75
Power of crane required	2	3	5	7	10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

GRABS TO WORK AT SLOWER SPEED than those last referred to, and differing from them slightly in design and in the cycle of operations, cost about 15 per cent. less than those illustrated in Figs. 2237 to 2242.

Fig. 2243

Fig. 2244

GRABS FOR LIFTING LARGE COAL, COKE, BALLAST, TOWN REFUSE, &c., (Hone's Patent).—The grabs, Fig. 2243 shown open and Fig 2244 shown closed are used for removing materials of the kind referred to, but the grab Fig. 2243 with angle steel tines, has the greatest penetrating power and should have the preference for many purposes.

The shell and frames are made of mild steel and the depressing gear is quickly changed to give a purchase of 2 to 1, or 4 to 1 as described at page 93. The bucket opens when the trigger, shown in the engraving, comes in contact with the crown.

The output given below is that obtained when discharging coal by ordinary cranes, the height of lift not exceeding about 30 feet and the range of slewing about half a circle. When lifting coke the weight will be relatively lower, but will probably be higher when working ballast or other heavy materials.

PRICES OF GRABS, Figs. 2243 and 2244.

Capacity of grab .. .. cubic feet	15	23	30	39	44	78
Price of grab	£78	£95	£100	£118	£129	£185
Approximate weight lifted per hour (coal). tons	20	31	37	45	50	72
Power of crane required .. .. ,,	3	3	5	5	7	10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

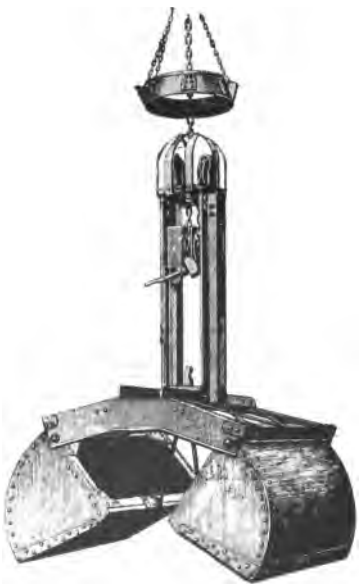


Fig. 2245.

Fig. 2246.

GRAB FOR LIFTING SMALL COAL, MUD, SAND, GRAIN, &c.—The materials of which the grab is made and the mode of opening are precisely as last described, but the jaws of the bucket meet closely to retain the small stuff whilst being lifted and slewed to the point of discharge.

PRICES OF GRABS, Figs. 2245 and 2246.

Capacity of grab .. .. cubic feet	15	23	30	39	44
Price of grab	£73	£90	£93	£112	£124
Approx. weight lifted per hour (coal), tons	15	23	30	39	44
Power of crane required .. .. ,,	3	3	5	5	7

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

Fig. 2247

Fig. 2248

HEMISPHERICAL EXCAVATORS.—The bucket is formed of three or of four segments, each of which resembles a pointed shovel, as indicated in the engravings Figs. 2247 and 2248.

The blades and appliances for closing are made of steel, and—being cylindrical—this form of excavator is less liable than any other to foul the sides when working in a well or cylinder or in limited space, such as between shorings, &c.

The ground is removed freely and rapidly and there is scarcely a limit to the height of working, either in excavating or discharging. It will be evident that the crane is available for manipulating the weights commonly used for sinking cylinders.

The cost of labour is very low, usually about 1 penny to 1½ pence per cubic yard excavated.

The four blade excavator, Fig. 2247 (Hone's Patent) is the most modern arrangement, and is provided with the appliances—referred at page 93—for increasing the penetrating power of the bucket to suit the materials to be excavated.

The opening crown used in connection with this excavator is automatic in action and is similar to that used for Fig. 2243.

PRICES OF FOUR BLADE EXCAVATORS, Fig. 2247.

Capacity of grab .. .. .. cubic yards	¾	1⅛	1½	2
Diameter when closed .. .. .. feet	4	4½	5	5½
,, ,, open .. .. .. ,,	7	7¾	8½	9½
Price of excavator	£125	£140	£175	£200
Approximate weight .. .. cwts.	22	26	30	40
Power of crane required .. .. .. tons	5	7	7	10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

The three blade excavator Fig. 2248 (Bruce's patent) is one of the earlier types of hemispherical excavators, but is still used by those who have had favourable experience of its performance in work already executed.

Opening gear.—The prices of these will be found at page 100. The speed of working is greatly increased by an automatic opening gear similar to that illustrated in Fig. 2241, &c.

PRICES OF THREE BLADE EXCAVATORS, Fig. 2248.

Capacity of grab .. .. .. cubic yards	⅛	¼	⅜	1
Price of grab	£60	£70	£80	£100
Power of crane required .. .. .. tons	2	3	5	7

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

BAG AND SPOON DREDGERS of the type Fig. 2249 have been largely superseded by appliances of the "grab" type, but they are still profitably employed for many purposes where a small quantity of work must be done intermittently and the outlay for a grabbing plant is inadmissable.

Fig. 2249.

The apparatus consists of a wrought iron frame to which a strong leather bag is laced as shown; the frame is provided with a socket in which the wood pole is secured, and a pair of chains for hauling in and filling the bag with the deposit to be removed. The front portion is spoon-shaped and faced with steel, to resist the wear and tear caused by dragging in mud, sand, or gravel.

The only plant required is a wrought iron davit and a crab with the necessary length of chain; these are fixed on a barge or stage, and the prices of the several parts are as follows :—

Small size bag and spoon with chains	£12 10 0
Large size ,, ,, ...	£14 10 0
Wrought iron davit with sheave	£3 10 0
Strong hoisting crab with fly wheel	£7 10 0
40 ft. best short link chain with swivel hook	£2 10 0

The cost of a steam winch or hoisting engine, with boiler mountings and connections, is about £150.

The cost of packing for shipment and delivery f.o.b. is 5 per cent

OPENING GEARS of various kinds have been used, that indicated in Fig 2250. which consists of a wrought iron forked lever suspended from the jib head and worked by a rod extending to the driver's platform, being a simple and (under certain conditions) a sufficiently satisfactory arrangement.

AUTOMATIC OPENING GEAR.—If, however, it is important that a high speed of working should be maintained, a crown similar to that illustrated in Fig. 2241 should be used in preference to that last referred to. The crown is suspended from the jib head at the height at which it is desired that the skip should be emptied; when it reaches this height the crown automatically engages the flange above the top of the skip in the manner illustrated in the above-named engraving; the lifting chain being then slightly slacked, the skip is instantly emptied, the reverse motion causes the clips to be automatically released and the skip is then ready for another operation.

Appliances for varying the height of discharge, prices for which will be found on next page, may sometimes be used with advantage, but, as a rule, every purpose is answered by attaching the opening crown to a pair of chains hung from each side of the jib head, the length being easily altered if required. Either of the opening gears can be fixed to any existing crane

PRICES OF OPENING GEARS.

Capacity of skips in cubic yards	¼ to ½	⅔ to 1
Price of lever, pin and rod as Fig. 2250	£4 0 0	£5 0 0
,, patent automatic crown	£7 0 0	£8 0 0
,, gear to alter height of discharge	£10 0 0	£16 0 0

MURRAY'S DROP-BOTTOM SKIP, Fig. 2250, the patent for which is the property of the writer, is invaluable for depositing concrete at any depth below water and for many other purposes where the appliances for emptying the skip must be worked from the driver's platform. The skips are made throughout of wrought iron or mild steel, and are rectangular, tapering outward from top to bottom, to ensure a free discharge when the bottom doors are opened. The central rod is connected with the doors, and they remain closed so long as the lifting chain is taut, but when the skip is held by the claw **A** and collar **B**, or by any other means, and the chain is slacked out, the bottom doors assume the position indicated by the dotted lines **C C**, and the contents of the skip are instantly discharged. In many cases a pair of iron, leather or strong canvas flaps have been used to cover the top and thus form a closed vessel in which the freshly made concrete is lowered to any depth required entirely undisturbed by current or "wash."

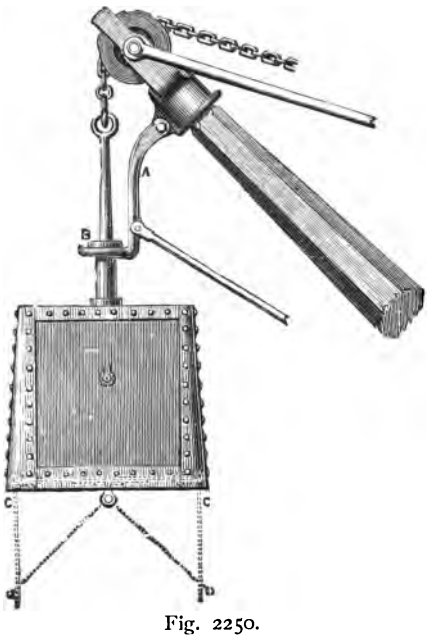


Fig. 2250.

FOR DISCHARGING GRAIN, COAL, BALLAST, ETC., the skips are usually cylindrical and are emptied by simply lowering on a hopper which supports the skip, the doors are then opened in the manner above described, and the materials are carried by a shoot, or otherwise, to the point required for storage or for distribution, as the case may be.

PRICES OF MURRAY'S DROP-BOTTOM SKIPS, Fig. 2250.

Capacity in cubic yds. ..	¼	⅓	½	⅔	¾	1
Price of skip complete ..	£8 8	£9 10	£10 15	£12 15	£15	£18

SKIPS AND BOXES FOR FRIABLE COAL.—Most English coal can be carried and tipped, in bulk, without undue breakage, but some foreign and colonial coal requires far more careful handling. There are many devices for this purpose, but they usually come under one of the undernamed categories :—

Anti-breakage boxes vary in capacity from 2 to 10 tons, but usually carry about 4 tons. A common form is a rectangular box or skip, with a sharply tapering bottom hinged to open outward or with a door at the side near to the lower end of the taper, the door in either case being arranged to open automatically, or otherwise, when the box has been lowered to the point for discharge.

Carrying boxes.—To save the cost of re-handling—in some cases—or of breaking friable coal in others, it is delivered from the mines (or import vessel) direct into square iron or timber boxes with appliances for slinging.

The capacity of the boxes varies from about 2 to 4 tons—usually the latter. The dimensions are those which will admit of them being stowed closely side by side on a platform truck, or in a barge.

Fig. 2251

Fig. 2252

WOODFORD'S SKIPS, Figs. 2251 and 2252 serve the same purpose as those last described (Murray's) and are worked in a similar manner, but these being semi-circular, are preferable for some purposes. The bodies are made of wrought-iron or mild steel. The prices, complete with all appliances ready to attach to the lifting chain, are the same as those given for Murray's skips, and the same opening gears may be used.

Skips of this type work to best advantage where it is not necessary frequently to detach them from the lifting chain. Under these circumstances work is done very rapidly, but if the skip has to be detached for filling or other purposes, preference should be given to the type Fig. 2250 or 2253, which are so largely used in connection with loading and discharging coal, minerals, mud, grain, and for many other purposes.

Fig. 2253

TURNOVER SKIPS, Fig. 2253, are constructed of wrought-iron or steel, the top being strengthened as shown, and of larger diameter than the bottom. The bow or "bail" is of wrought-iron, working freely on a pair of trunnions, which are so arranged that when the skip has reached the position in which it should be emptied—the catch being released—the skip turns over; when empty it returns to its original position ready for another operation.

The bottom plate may be flanged, or if desired, it is formed of a flat plate and secured to the shell by a strong angle iron, this construction being in some cases preferable to that first named. It may be mentioned that skips of ¾ cubic yard capacity are generally used for working coal, iron ore, ballast, &c., those for grain and similar products being of 1 cubic yard capacity.

When discharging coal, ore, grain, &c., it is frequently convenient to have the skips mounted on rollers, and the cost of these will be found in the list of prices.

PRICES OF TURNOVER SKIPS, Fig. 2253.

Capacity of skip .. cubic yards	¼	½	⅔	¾	1
Price of skip	£6 0 0	£7 5 0	£8 5 0	£9 0 0	£10 0 0
If with swivel eye in bow .. extra	£0 10 0	£0 11 0	£0 12 0	£0 13 0	£0 15 0
If with rollers and pedestals ,,	£1 0 0	£1 5 0	£1 10 0	£1 15 0	£2 5 0

Fig. 2254

COMBINED SKIPS AND TIP WAGONS.—Fig. 2254 represents one of the numerous types of skips and trucks which are used in conjunction with cranes for carrying coal, iron ore, ballast, grain, and sometimes even liquids. The frame is constructed of wrought iron or mild steel, with buffer plate as shown, and is supplied complete with coupling-hook and chain. The wheels are usually 10 inches diameter and are made of crucible cast steel, specially hard to withstand the constant wear that comes upon them; the axles are of mild steel of sufficient length to suit the gauge of rails on which the truck has to travel; 18, 24 or 30 inches are the usual gauges. The body is made of boiler plate strengthened at the top by a wrought iron band, the bottom being dished and rivetted to the shell. The trunnions are fixed in a suitable position for turning over, for discharging, and automatically returning when empty; the sides being strengthened as shown. Lugs or hooks are rivetted to the sides for lifting with the crane slings, and provision is made for securing the skip in position when the truck is travelling.

PRICES OF COMBINED SKIPS AND TIP WAGGONS, Fig. 2254.

Capacity of skip ..	cubic yards	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Price	.. ..	£11 10 0	£13 15 0	£16 10 0	£20 0 0
Approximate weight ..	.. cwts.	$5\frac{3}{4}$	$6\frac{1}{2}$	$7\frac{1}{4}$	$8\frac{1}{2}$

The cost of packing for shipment and delivery f.o.b. is usually 5 per cent.

OPEN END SKIPS, CRADLES, Etc., are frequently useful adjuncts to steam or hydraulic cranes for handling small stones, minerals, sleepers, timber, &c., with or without appliances for discharging automatically, and these can usually be designed to fulfil the conditions required if full particulars are given.

LIFTING CLAWS for lifting and slipping concrete blocks, bags of cement, stones, &c., are made of various types to suit the work to be performed.

The appliances shown in Fig 2166 (principally used for formation in "pierres perdues" referred to at page 23) consist of two steel girders with cross bracing and a heavy steel pin secured in bosses at the ends of the girders A pair of strong steel jaws are suspended from the above named cross bars and are capable of gripping and lifting blocks or bags of any weight up to 40 tons and of any length between about 7 and 10 feet.

The jaws open automatically if the load is lowered into position as in foundations or dock walls; but the under-named, or some other form of releasing gear, is required if the blocks are to be dropped from the slings.

The "slipping" gear for releasing the block from the lifting claws, is worked by steel wire ropes attached to the lifting claw frame and carried over pulleys at the head of the jib, to the deck of the pontoon. When the block is in the position desired, the pontoon end of the wire rope is secured in appliances fixed near to the foot of the jib and the lifting block lowered out. This causes the jaws to open sufficiently to release the block.

The price of the lifting claws with beams, &c. as above described is about.. £80.

The price of the slipping gear, including the sheaves at the jib head, rope grippers and accessories is about .. .. £70.

BLOCK LIFTING BEAMS AND SUSPENSION LEWIS BARS, used in connection with Titan, Goliath and other cranes for depositing blocks of great weight and bulk, are arranged to take the suspension bars or slings at fixed or at variable distances apart. The latter arrangement (indicated in Fig. 2152) admits of the same beam being used for blocks of different shapes and sizes. and is frequently adopted.

The well known action of sea water on steel renders it desirable to make these beams and bars of Lowmoor or other high class iron; but steel is quite satisfactory when the work does not extend over a long period.

The Lewis bars, for suspending the block from the lifting beam, are made with **⊥ head** and this, as well as the eye, is forged solid—not welded.

The price of Lowmoor iron beam and two Lewis bars, equal to a load of 40 tons is about .. .. £70.

The price of wrought iron or forged steel beam and bars is about .. .. £50.

CLIPS OR TONGS FOR LIFTING TIMBER, STONES, &c., are arranged for use in connection with swing jib, or overhead travelling cranes. The appliances for gripping or releasing the load can be controlled by the crane driver, if desired.

INGOT TONGS.—By a modification of last named arrangement, hot ingots or forgings are manipulated rapidly and without risk to workmen in slinging, &c.

DOUBLE CHAIN SLINGS are made of best tested short link crane chain, the ends welded to form an endless chain of the length stated.

PRICES OF DOUBLE CHAIN SLINGS.

Working load .. .. cwt.	2½	4	6	8	12	20
Length of sling .. .. feet	8	9	12	16	20	25
Price of ,, ...	4/6	5/-	7/6	10/-	12/6	15/-

CLAW SLINGS FOR LIFTING CASES.—The two chains of best tested quality are connected at the top by a ring for attachment to the hook on the crane chain; the lower ends are provided with steel pointed claws for gripping the load.

PRICES OF CASE SLING.

Working load .. .. cwt.	2½	4	6	8	12	20
Price of sling	7/6	9/-	12/6	15/-	17/6	20/-

SLINGS FOR LIFTING CASKS are made of best tested endless chain, and provided with hooks to grip each end of the cask.

The hooks are steel pointed and fitted with rollers which admit of the chain adjusting itself when lifting commences.

PRICES OF CASK SLINGS.

Working load .. .. cwt.	2½	4	6	8	12	20
Capacity of cask . gallons	18	36	54	72	110	164
Price of sling	6/6	8/6	10/-	12/6	15/-	17/6

SUSPENDED WEIGHING MACHINES perhaps scarcely come into the category of "Accessories for Cranes," but a portable machine, suspended from the lifting chain hook or loop, is frequently very convenient for weighing goods when slung for removal to or from vessels, railway trucks, &c., and for use in factories, warehouses, foundries and other works.

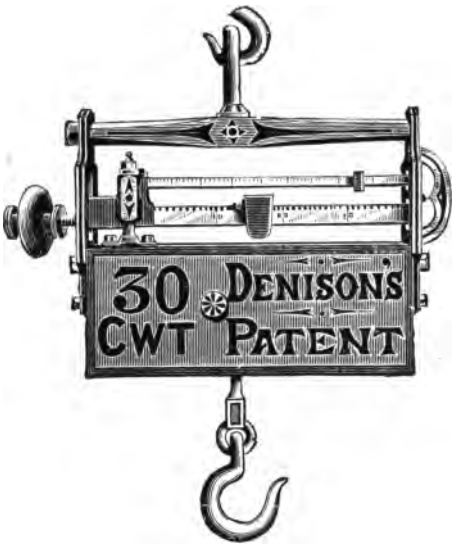


Fig. 2255.

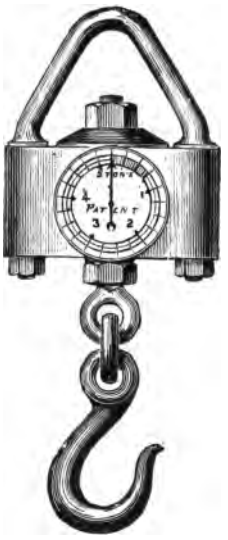


Fig. 2256.

PORTABLE STEELYARD (OR LEVER) WEIGHING MACHINE — Fig. 2255 represents a machine (Denison's patent) to record in lbs. up to 1½ tons, but similar machines are made of all powers from half-a-ton to 60 tons, and all are constructed on the same principle as a platform weighing machine of the usual type.

All points of contact are in hardened steel, the working parts are enclosed in an iron or steel case and every machine is tested to 20 per cent beyond its maximum working load.

The limits of accuracy are within about 1 lb. in machines to weigh up to 5 tons and the larger sizes are proportionately sensitive.

Graduation.—The steelyards are usually marked for tons, cwts, quarters and lbs. but they are graduated to any foreign standard, at a small extra cost.

If a machine is much exposed, the graduated arm should be made of brass; the extra cost of this is about 2½ per cent.

Machines exceeding 10 tons power should have a swivelling eye in lieu of the bottom hook used for the smaller machines; the extra cost of this is about 5 per cent.

Taring apparatus.—The weight of sling, case, &c., is tared by regulating the position of the counterweight at the pivot end of the steelyard which, therefore, registers the net weight of the load when the indicator is adjusted in the usual manner.

PRICES OF LEVER WEIGHING MACHINES, Fig. 2255.

Power of machine	tons	1	1½	2	3	5	10	20	30	40
,, ,,	kilog.	1,000	1,500	2,000	3,000	5,000	10 000	20 000	30 000	40 000
Price of machine	..	£10	£13	£16	£20	£28	£35	£48	£65	£80
Approx. weight	lbs.	70	100	125	140	200	340	710	930	1,200

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

THE PORTABLE HYDROSTATIC WEIGHING MACHINE, Fig. 2256, (Duckham's patent) records, on a graduated dial, the pressure exercised by a piston of given area on oil or other liquid enclosed in a chamber. This is effected by suspending the load from the loop on the lower end of the piston rod, the pressure (in tons or other standard) due to that load being indicated by the pointer.

This simple and compact apparatus does not indicate weights so closely as a steelyard lever machine, but it does so with sufficient accuracy for use in docks and harbours, railway goods yards, arsenals, ironworks, &c., where they are largely used.

The smaller sizes are graduated to read off to 7 lbs., and the marking on the larger sizes is as close as can conveniently be read.

The dials are marked for **tons, kilogrammes, poods** or any other standard of weight, and the machines are made for all powers from 1 to 150 tons. The test load is 50 per cent. beyond that for which the dial is graduated.

PRICES OF HYDROSTATIC WEIGHING MACHINES, Fig. 2256.

Power of machine tons	1½	3	5	10	20	30	50	80	100
,, ,, kilogs.	1,500	3,000	5,000	10.000	20 000	30 000	50 000	80 000	100000
Price of machine ..	£13	£14	£18	£23	£34	£38	£56	£95	£110
Approximate weight lbs.	63	70	90	127	342	560	840	1400	1450

The cost of packing for shipment and delivery f.o b. is 5 per cent.

LOCOMOTIVE WHEEL WEIGHING MACHINES on the steelyard lever principle (Fig. 2255) are made to show the exact load on each wheel of a locomotive.

Machines for this purpose are specially designed in accordance with details supplied by the locomotive engineer.

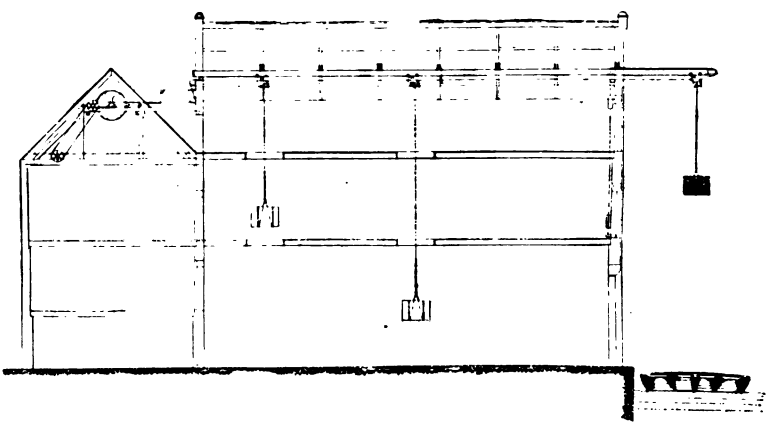


Fig. 2256*.

TRANSPORTERS.—The diagram Fig. 2256* directs attention to a system of lifting and traversing machinery for loading, discharging or storing coal, ore, merchandise, building materials, &c., which is employed under widely differing conditions and with equal advantages on land or afloat.

The height of lift and length and angle of traverse can be varied to any extent. The longitudinal beam may project any distance beyond the point of support, or it may be suspended and adjusted to work at an angle, or to swivel to right or left as required for convenient distribution of loads. The plant illustrated is equal to a working load of one ton; the beam projects about twelve feet beyond the quay and the total traverse is about eighty feet.

The traversing gear consists of a carriage with travelling wheels and hook or loops from which the load is suspended; the traverse is automatically arrested at any point desired, and held in position whilst the load is being lifted or lowered. All motions are worked by one rope.

The driving machinery in the building selected for illustration is in the roof, but steam, electric or other motive power may be used, and can be fixed in any convenient position relatively with the longitudinal beam.

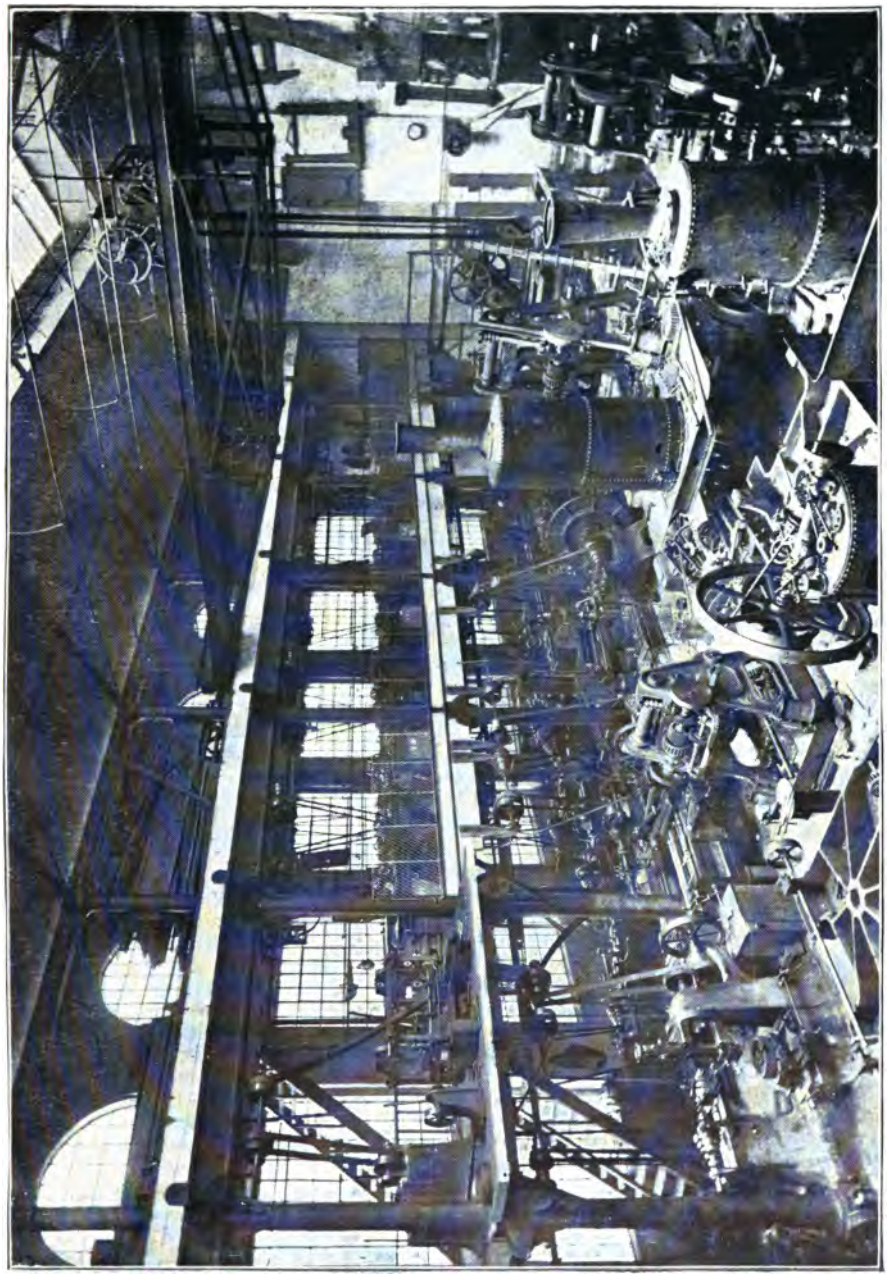


Fig. 2257

OVERHEAD TRAVELLING CRANES

These being essentially "labour saving machines" the question of highest efficiency seems to be worthy of at least as much consideration as that given to the machine tools or other appliances in connection with which the cranes are used.

That they are also "space saving machines" is sufficiently indicated in the engraving Fig. 2257 of the interior of works designed by the Writer to completely utilize the floor space.

The engravings Fig. 2258 to 2272 represent most of the types of overhead travelling cranes in general use, but many modifications—made to fulfil exceptional conditions—must remain unnoticed.

These exceptional conditions are frequently inevitable when cranes are put into existing buildings and may consist of:—

1. Limited space between longitudinal rails and the walls or supports, or between the longitudinal girders and the roof ties or upper floor.
2. Special arrangements (*a*) for the transmission of power; (*b*) for the position of the attendant; or (*c*) for automatically gripping or releasing loads, as in steel works, timber, or stone yards, &c.

The best results may be anticipated when the architect's designs can be prepared in co-operation with the crane builder.

Overhead steam travelling cranes.—The designs for the first crane of the type Fig. 2258 were made in the office of the late Mr. (subsequently Sir Joseph) Whitworth, more than 50 years ago, and it is worthy of record that those designs embodied the essential mechanical features adopted in the most recent practise.

Shaft driven overhead travelling cranes.—The next improvement—following closely on that last named—was devised by the late Sir Andrew Fairbairn and consisted in the application of a longitudinal shaft, supported on tumbler bearings in the manner indicated in Fig. 2262, for driving his shop travellers.

The speeds of these cranes (still working) do not differ materially from those referred to later on and now generally used.

Cotton cord driven overhead travelling cranes.—The high speed cord system illustrated in Fig. 2267 was invented by the late Mr. Ramsbottom for service in the celebrated Locomotive Works at Crewe, with which his name is inseparably connected.

The cord runs at a speed of about 5000 feet a minute and the system is in successful operation in all parts of the world, but is now less frequently adopted than the rope driving system, Figs. 2265 and 2266, also first used by Mr. Ramsbottom.

Rope driven overhead travelling cranes.—Figs. 2265 to 2266 illustrate different arrangements of cranes driven by hemp rope running at a speed of about 2000 feet per minute. The results obtained from this mode of driving are so good, that more of these cranes are made now than of all those above named collectively.

Electric overhead travelling cranes, Fig. 2268.—The last (and perhaps not least important) improvement is the use of the electric motor, in lieu of the above-mentioned modes of transmitting power. The current is conveyed to and returned from the crane by overhead conductors, with connections between them and the motors, as described in the remarks on "Electric Cranes" at page 69.

Speeds of working.—Power driven overhead travellers have two or more purchases speeded to suit the purpose for which the crane is employed. The speeds for travelling and traversing range from 25 to 60 feet per minute, or more; the lifting speeds enumerated below may be regarded as generally applicable for lifting the maximum loads.

The lifting speed of rope driven cranes is limited, to some extent, by the fact that the normal tension on the driving rope ought not to exceed about one-fiftieth of the breaking strain.

Power of crane	tons	3	5	10	15	20	30
Speed per minute, max. load	feet	30	18	9	6	4½	3

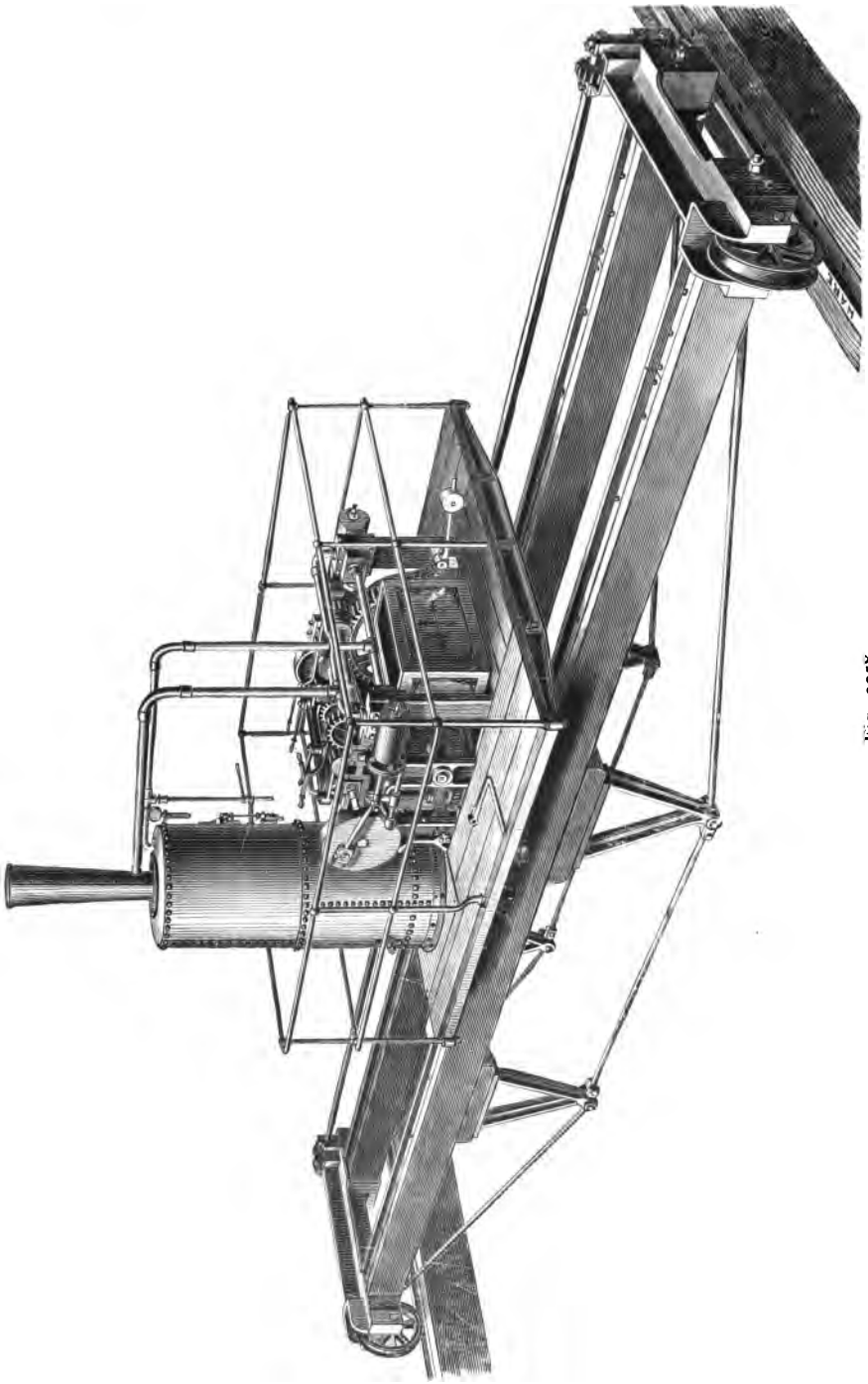


Fig. 2258

Hand power overhead travelling cranes.—Having regard to the limited power available, it is evident that true economy lays in the direction of obtaining excellence in design and workmanship. The remarks on pages 1 and 3, respectively on "Weight of machines" and "Hand power cranes" are peculiarly applicable to overhead travellers.

Manual labour is—at best—an uncertain quantity, and loss in time and labour soon absorbs far more than the difference between the cost of a crane of good design and one of inferior type.

OVERHEAD STEAM TRAVELLING CRANE WITH TRAVERSING CRAB, Fig. 2258.—The twin engines and all the gear for lifting and transmitting the travelling and transversing motions form part of the crab which is mounted on double flanged wheels, and provided with steam boiler, coal bunker, feed water tank, and all accessories for these, the whole being so arranged that one man works the traveller and attends the boiler. The motions can be worked separately or in any combination.

Cranes up to 10 tons power have double purchase gear and those of higher power, treble purchase; appliances for working by hand power can be added, if desired.

The girders are now usually made in wrought iron or steel, and this construction is contemplated in the following list of prices. The cranes are complete with chains or steel wire ropes and lifting block.

PRICES OF OVERHEAD STEAM TRAVELLING CRANES, Figs. 2258 AND 2259.

Power of crane .. .. tons	5	10	15	20	25	30	40	50
Span ,, ... feet	40	40	40	40	40	40	40	40
Height of lift .. .. ,,	20	20	20	20	20	20	20	20
Price of crane	£400	£500	£600	£720	£830	£930	£1125	£1300
,, per foot extra span (to 50 ft)	£6	£7	£8	£9	£10	£11	£12	£13
,, galvanized iron house ..	£25	£26	£26	£27	£28	£28	£30	£30
,, ,, ,, canopy ..	£10	£12	£14	£15	£16	£17	£18	£20
Approx. weight .. .. tons	11	15	17	23	26	30	36	40

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

OVERHEAD STEAM TRAVELLING CRANES WITH FIXED CRAB, Fig. 2259.—The crab is fixed at the end of the main beams, the object being to always have its weight over one of the longitudinal rails (or nearly so) leaving only the working load to be carried on the traveller girders and the other (outer) rail.

This arrangement is exceptional, and is illustrated because in certain cases it has been found of great advantage to lift close to the outer rail and to have a gantry of lighter construction than would be necessary if the crab and load traversed the main girders, as shown in Fig. 2258.

The lifting and traversing motions are performed by two barrels which, when lifting, are driven in the same direction, but clutches are provided which admit of one barrel being reversed; this provides for traversing the jenney without alteration in the height of the load.

Cranes of this type were used for lifting and weighting the cylinders which form the piers of the Charing Cross and Cannon Street Bridges and, subsequently, in many similar operations.

The prices are, approximately, as given above.

SHAFT DRIVEN OVERHEAD TRAVELLING CRANES.—Figs. 2260 to 2262 illustrate this system of transmitting power, which has long been used for overhead travelling cranes of all powers in foundries, locomotive and other engineering shops, boiler and bridge works, quarries, &c.

The main driving shaft may be above the crane, as shown in Fig. 2260, or below it as in Fig. 2262; two crabs may be carried on one crane and two or more travellers are driven from one main shaft. In one well known marine engine works three cranes are driven off the same shaft, one of 50 and two of 15 tons power.

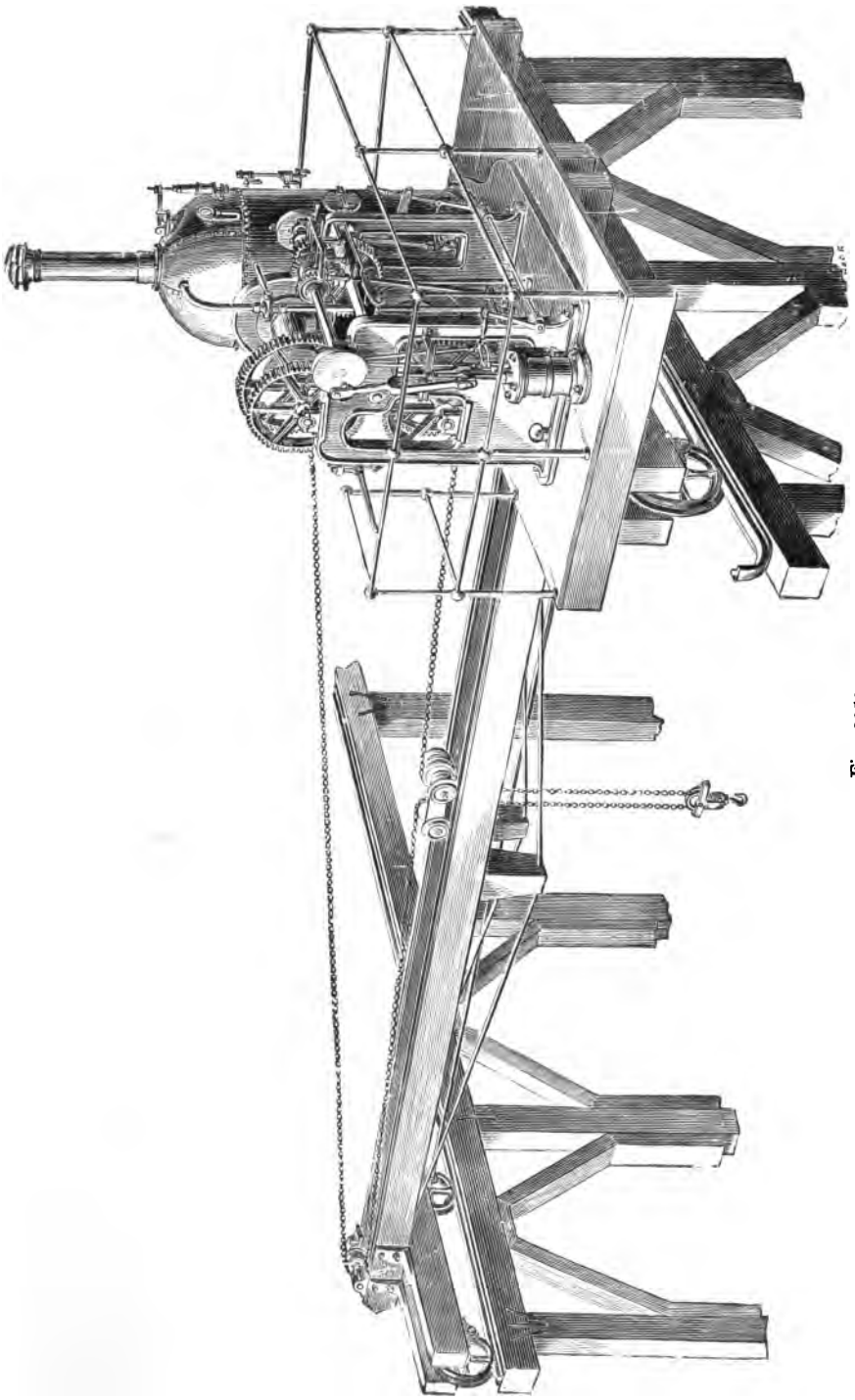


Fig. 2259

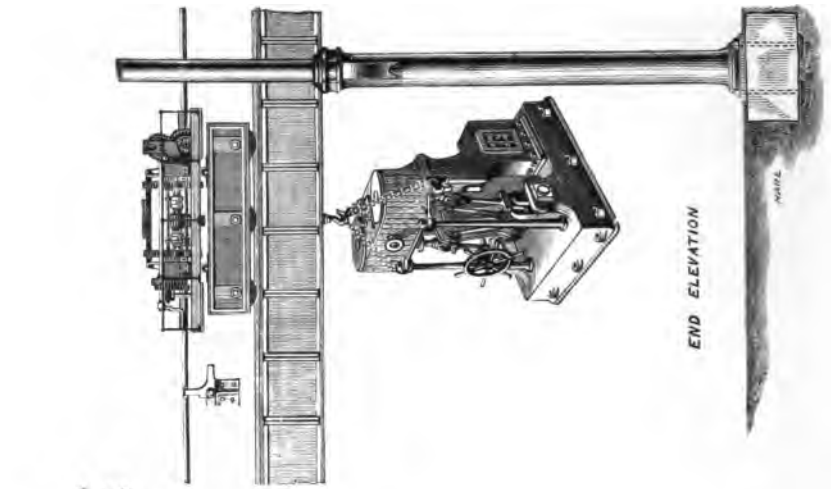


Fig. 2261

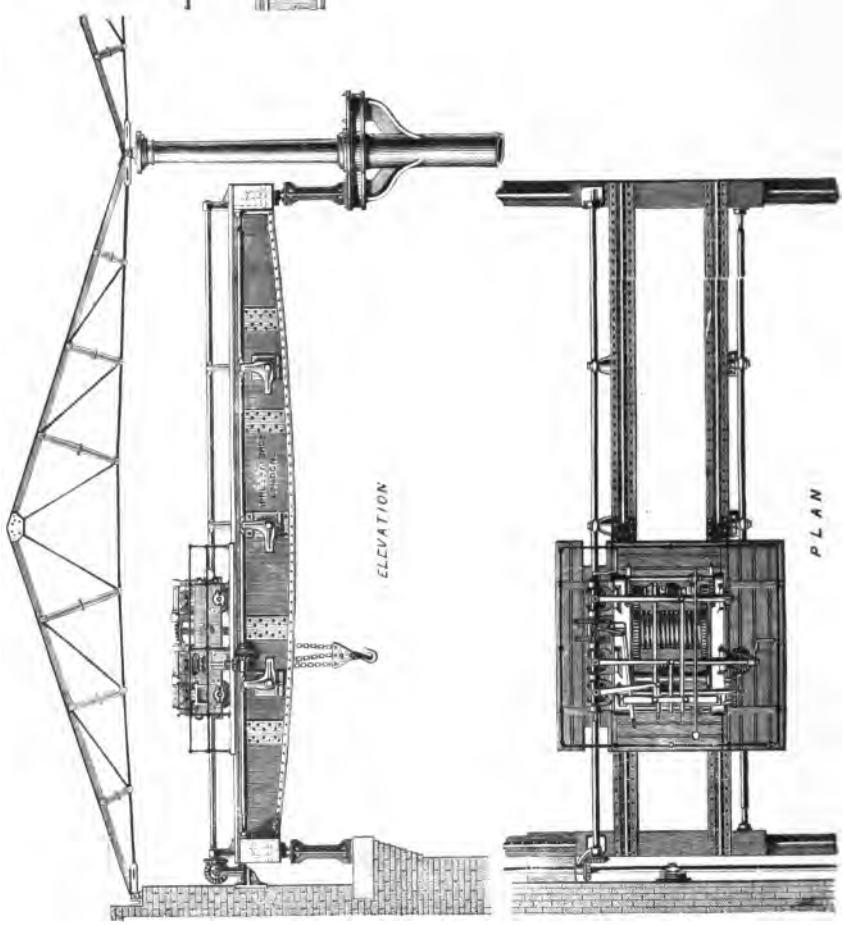


Fig. 2260

Cranes of 50 to 100 tons power are constructed as shown in Figs. 2260 and 2261 which illustrate in elevation, plan and end section, the 50 tons crane above referred to; the span is 45 feet and the height of lift about 35 feet.

Cranes up to 50 tons power.—Fig. 2262 illustrates one of 40 tons power and 38 feet span, built for a foundry and is generally typical of the construction adopted for lower powers, the details of girders, &c. being modified to suit the conditions to be fulfilled.

The girders and end cradles for both the above mentioned cranes are of box section, with steel rails rivetted to the girder which carries the crab; the end cradles are fitted with double flanged steel wheels and all appliances for travelling. For spans under 40 feet single web girders are generally found sufficient.

The crab is mounted on double flanged steel travelling wheels, the purchases are changed by hand wheels and screw and all motions are operated by double friction cones on the first motion shaft, power being transmitted from the longitudinal shaft shown in the engravings. The brake—also operated by screw and hand wheel—is on the second motion shaft.

The clutches, both for changing the purchases and the direction of motion are worked from the side platform, or from one attached to the crab, as shown respectively in Fig. 2260 and 2262.

The lifting barrel is grooved spirally and coils the full length of chain, without overlap; the wheels are keyed to the ends of the barrel so that there is no torsional strain on the barrel shaft.

The longitudinal shaft is square (excepting where it is turned for bearings), or round with a key way throughout its length, but almost invariably the former. It is made in convenient lengths which are connected by a joint of special design.

The bearings illustrated by Figs. 2263 and 2264 are automatically depressed by an inclined plane at one end of the crane carriage and raised by a similar arrangement at the other end, so that the shaft is always firmly supported. They are usually fixed below the crane but, as above indicated, they may be above it if this is more convenient.

PRICES OF SHAFT DRIVEN TRAVELLING CRANES, Figs. 2260 AND 2262.

Power of crane .. tons	5	10	15	20	30	40	50	60	80
Span ,, .. feet	40	40	40	40	40	40	40	50	50
Price ,, ...	£355	£440	£525	£680	£895	£1050	£1260	£1575	£2100
,, per foot extra (to 50 ft.)	£6	£7	£8	£9	£10	£10	£12	..	..
Approximate weight .. tons	10	13	16	20	25	30	35	40	55

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

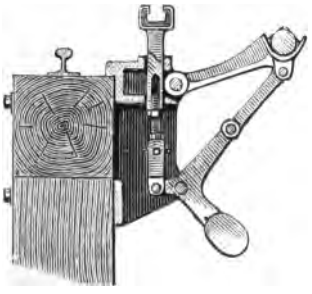


Fig. 2263.

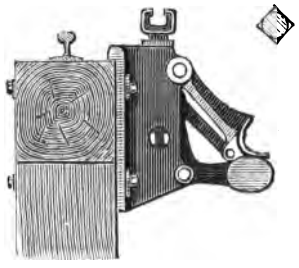


Fig. 2264.

THE SELF-LOCKING BEARINGS, referred to in the foregoing description of shaft driven overhead travelling cranes, are automatically depressed and locked in position to firmly support the shaft, as shown respectively in Figs. 2263 and 2264 and are easily adjusted Any number of cranes can be driven from one line of longitudinal shaft.

PRICES OF SELF-LOCKING BEARINGS, Figs. 2263 and 2264 and SQUARE SHAFT.

Dimension of square shaft	2	2½	3	3½	4
Price of one bearing and 12 feet of shaft	£6	£7	£8	£9	£10
Approximate weight .. .. cwts.	3	4	5	6½	8

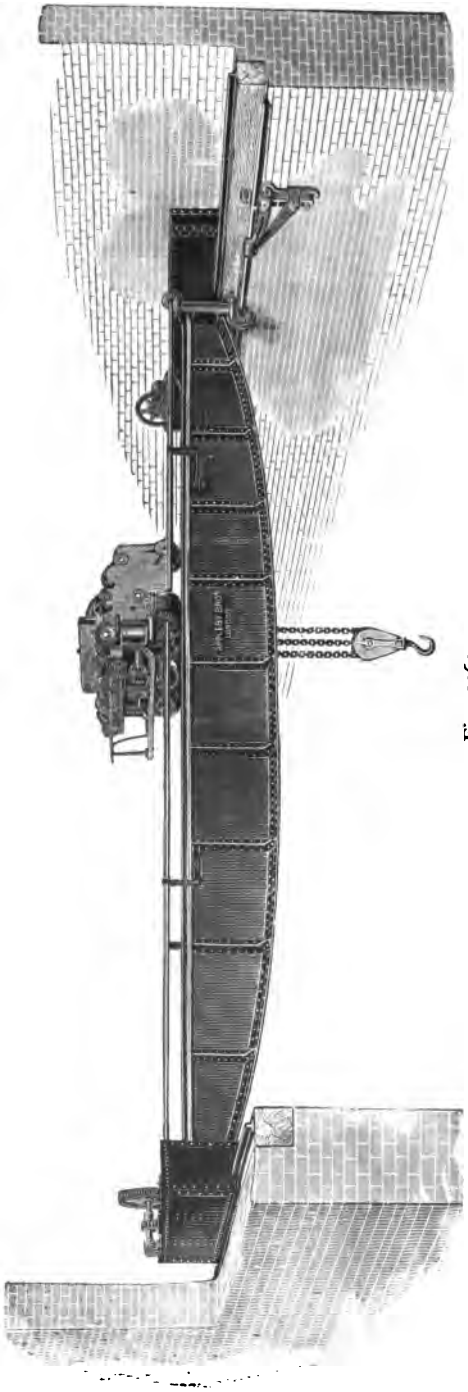


Fig. 2262

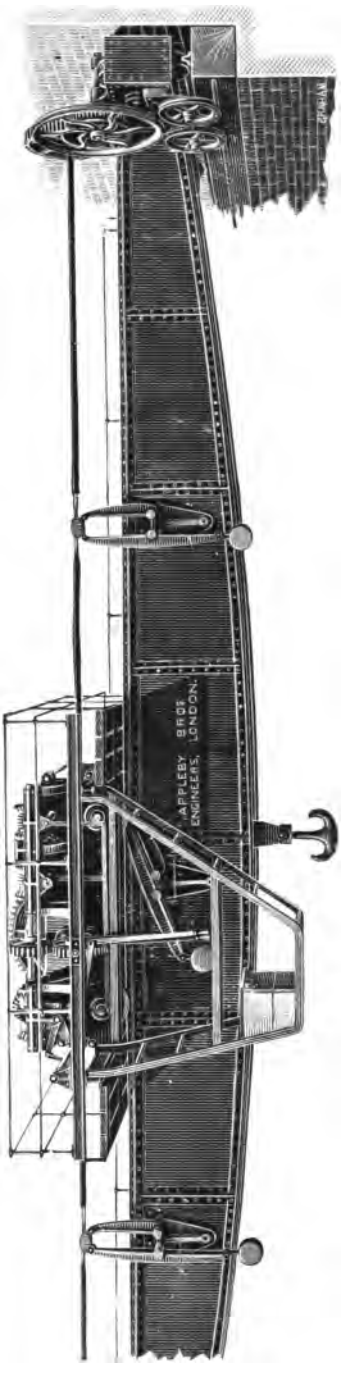


Fig. 2265

ROPE DRIVEN OVERHEAD TRAVELLING CRANES.—Figs. 2265 and 2266 represent cranes differing in arrangement as respectively described but, in both cases, power for all motions is transmitted by an endless hemp rope 1¼ inch diameter running at a speed of about 2,000 feet per minute.

ROPE POWER TRAVELLERS DRIVEN BY REVERSIBLE FRICTION CONES.—The crane Fig. 2265 is of 35 tons power and 49 feet span and represents one of several cranes, varying in span from 45 feet to about 60 feet, which were built for extensive marine engine works. The height of lift is about 30 feet and the length of travel nearly 300 feet.

The principal erecting shop is equipped with two of these cranes and both are worked by the same endless rope. The other erecting shops are each provided with one traveller of the power above named and the subsidiary shops with cranes of 3 and 5 tons power.

The foundry, in these works, is provided with two overhead travellers similar to those in the erecting shop; the span is 60 feet and the height of lift 40 feet. Both cranes have two crabs, each of 20 tons power, and capable of being used separately or in combination, so that one crane is used for loads up to 40 tons or—in case of need—the two cranes will deal with any weight up to 80 tons.

The girders and end cradles are built of mild steel, of box section, and have a factor of not less than 6 (six).

The motions for lifting, traversing and travelling are effected by a rope passing over the grooved pulley at one end of the shaft which extends the whole length of the main girders. The two guide pulleys serve to maintain the grip of the rope over about two-thirds of the circumference of the main pulley and the shaft (thus driven), transmits the motions for lifting, lowering, traversing and travelling, in the combination desired; these are worked by double cone friction clutches controlled by levers within reach of the attendant, when seated in the cage suspended from the crab.

OVERHEAD POWER TRAVELLER DRIVEN BY ROPE AND BELTS.—Fig. 2266 is reproduced from a photograph of one of the rope driven cranes in the London Steam Crane and Engine Works at Leicester, and represents the most modern arrangement of belt driven overhead travelling cranes.

The girders are of wrought iron and give a factor of 6. The end cradles, which carry the travelling wheels and gear, are of box section and the crab is arranged to traverse the load quite near to the longitudinal beams.

The motions for lifting or lowering and those for traversing or travelling in either direction—in any combination—are transmitted noiselessly by belts, instead of by friction clutches and gear; this arrangement is favourable to rapid working and to absence of "shock" in stopping or starting. All motions are controlled by levers within reach of the driver who is stationed on the platform suspended from the main girders, as shown in the engraving, where he has a clear view of the work to be performed.

It may here be mentioned that by an arrangement of different sized pulleys driven by open and cross belts for actuating the lifting and lowering motions, the speed of lowering is nearly double that of lifting.

Cranes of all powers up to 100 tons and for any span, are constructed in the manner above indicated and a large number of them are in continuous service in all parts of the world.

The approximate prices given in the following table include the best tested chain and blocks for a vertical lift of about 20 feet, the V grooved pulley and tension gear for the driving rope, side platform and handrail, and the driver's platform.

The cost of endless driving rope and accessories for carrying it, for any length of travel, can be ascertained by reference to the following table.

Special engines for driving travellers.—if power cannot conveniently be transmitted from existing shaft, or (as often happens) the crane must frequently work when the main engine is standing, a special double cylinder vertical or horizontal engine is fixed to wall or floor for driving one or more cranes. Steam is taken from the main boilers and this arrangement is often found to be both economical and convenient.

The subjoined prices of engines include the V grooved driving pulley and all accessories ready for fixing.

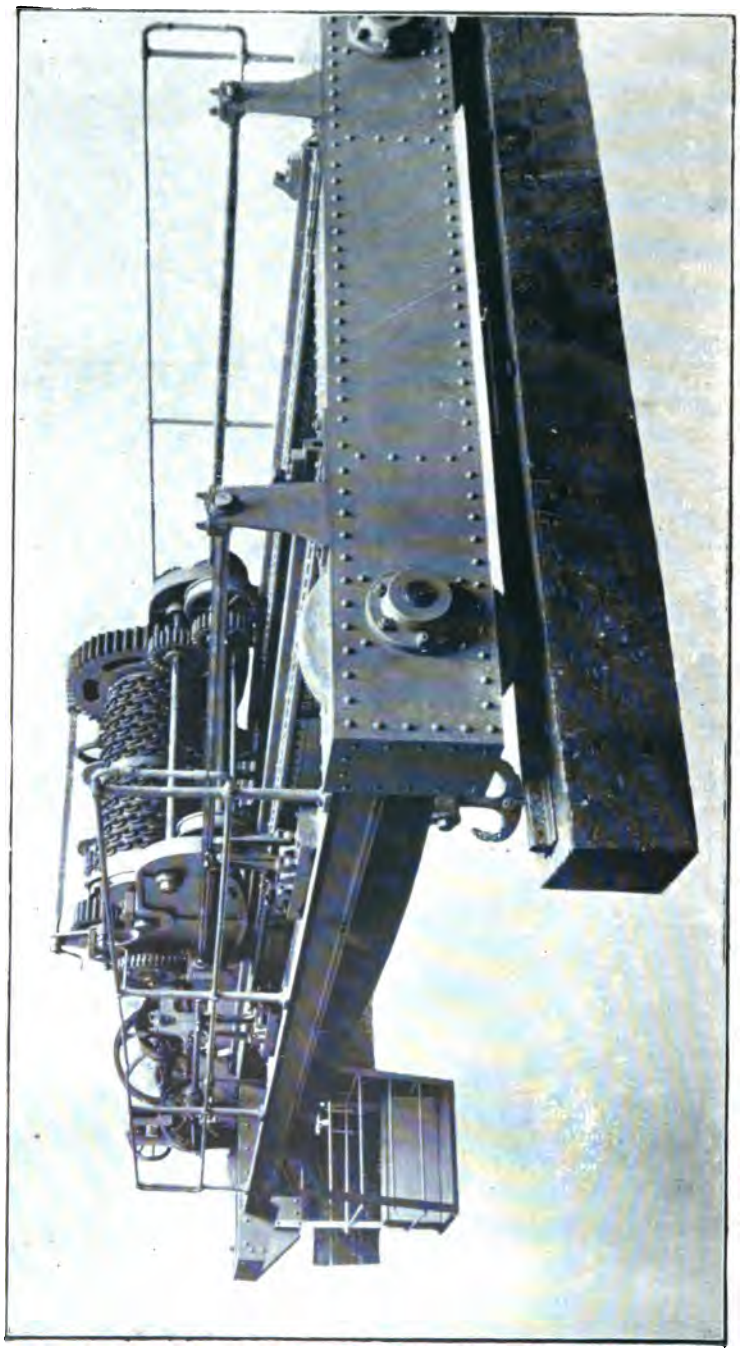


Fig. 2266

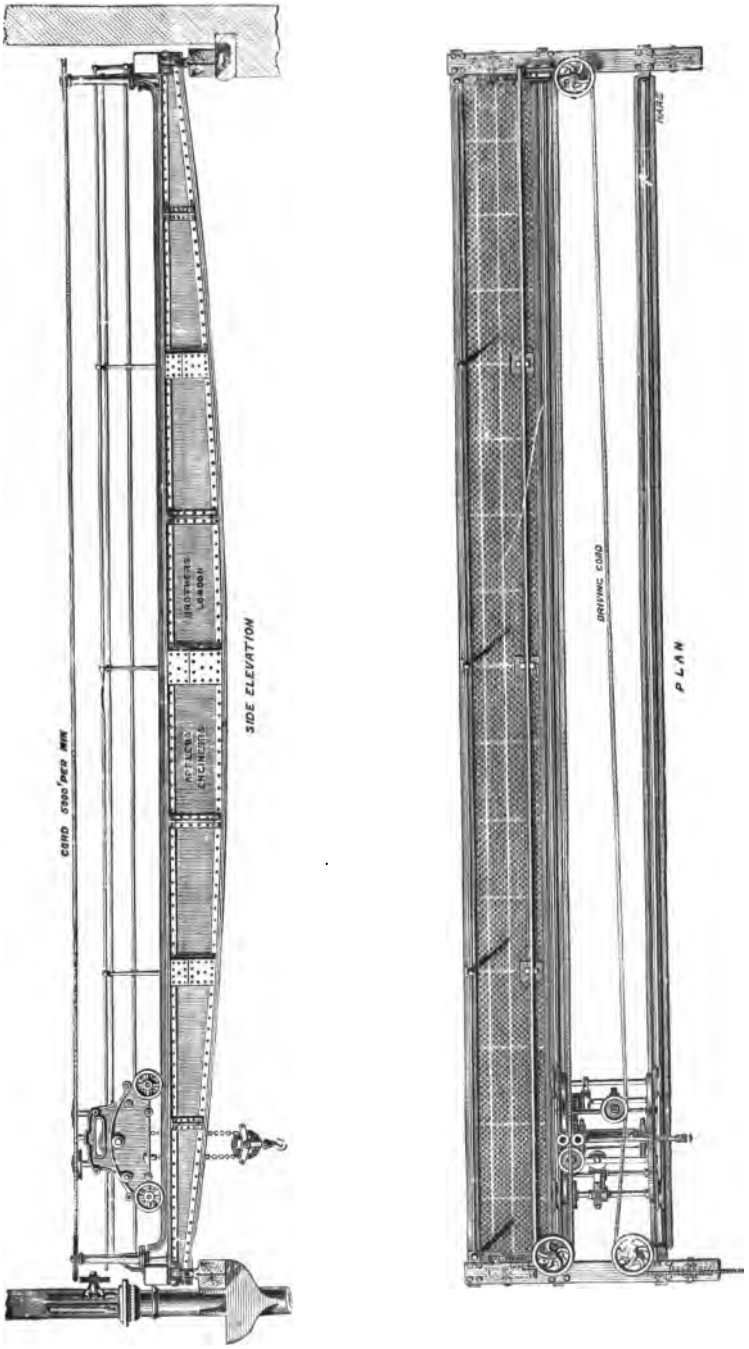


Fig. 2267

Electric motors for driving travellers.—This system of driving is- in some cases—even more advantageous than that last referred to. The prices of motors of various powers will be found at page 77 of Section I of the Handbook, but the approximate cost of a motor of suitable power, with driving pulley, is given in the following table.

PRICES OF ROPE DRIVEN OVERHEAD TRAVELLING CRANES, Figs. 2265 and 2266.

Power of crane .. .. tons	5	10	15	20	30	40	50
Span ,, ... feet	40	40	40	40	40	40	40
Height of lift .. .. ,,	20	20	20	25	25	30	30
Price of crane and tension gear ..	£390	£505	£600	£765	£990	£1155	£1355
,, rope and guide pulleys per 12 feet of gantry	£6	£6	£7	£8	£9	£9	£10
,, engines and driving pulley	£70	£75	£80	£85	£100	£100	£100
,, electric motor and ,,	£80	£90	£100	£110	£130	£150	£170
Approximate weight of crane tons	12	14½	18	24	30	35	40

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

COTTON CORD DRIVEN OVERHEAD TRAVELLING CRANES.—Fig. 2267 illustrates a crane of 5 tons power and 50 feet pan which forms part of the equipment of a main line carriage works, and is driven by an endless cotton cord about ⅝ inch diameter which travels at a speed of 5,000 feet per minute. In the works referred to, two cranes are driven by one line of cord; in others—more especially locomotive shops—the cranes frequently carry two crabs, each of 15 to 35 tons power, which are used separately, or together, as required.

The girders and end cradles are of steel, box section, with a side platform for the attendant, the pinions and travelling wheels are of steel and the grooved pulleys which carry the driving cord are turned and accurately balanced.

The lifting motion is obtained by bringing the driving cord into contact with the balanced cone pulleys shown in the engraving, by hand levers. The reverse motion is effected by transferring the cord to the opposite side of the driving pulley.

The travelling and traversing motions are operated by means of a papier-maché disc which is pressed into contact with the flanges of a cast iron bobbin constantly revolving, the motion being reversed by pressing the disc against the opposite flange.

Starting and stopping.—Appliances are provided whereby the driver can stop the working of the driving cord when desired, so that wear and tear of rope and machinery are limited to the time during which the crane is usefully employed.

The subjoined prices include lifting chains, blocks, driving and tension apparatus, but not the driving cord and carrying pulleys; the data for estimating the cost of these, for shops any length, will be found below.

PRICES OF COTTON CORD DRIVEN TRAVELLERS, Fig. 2267.

Power of traveller .. tons	5	10	15	20	25	30	40	50
Span ,, .. ,,	40	40	40	40	40	40	40	40
Price of crane	£320	£405	£490	£650	£750	£850	£1000	£1200
,, cord and carrying pulley for 12 feet	£6	£6	£7	£7	£7	£8	£9	£10
,, extra span per foot to 50 feet ..	£6	£7	£8	£9	£10	£10	£11	£12
Approximate weight .. tons	10½	12	14	20	23	26	29	33

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

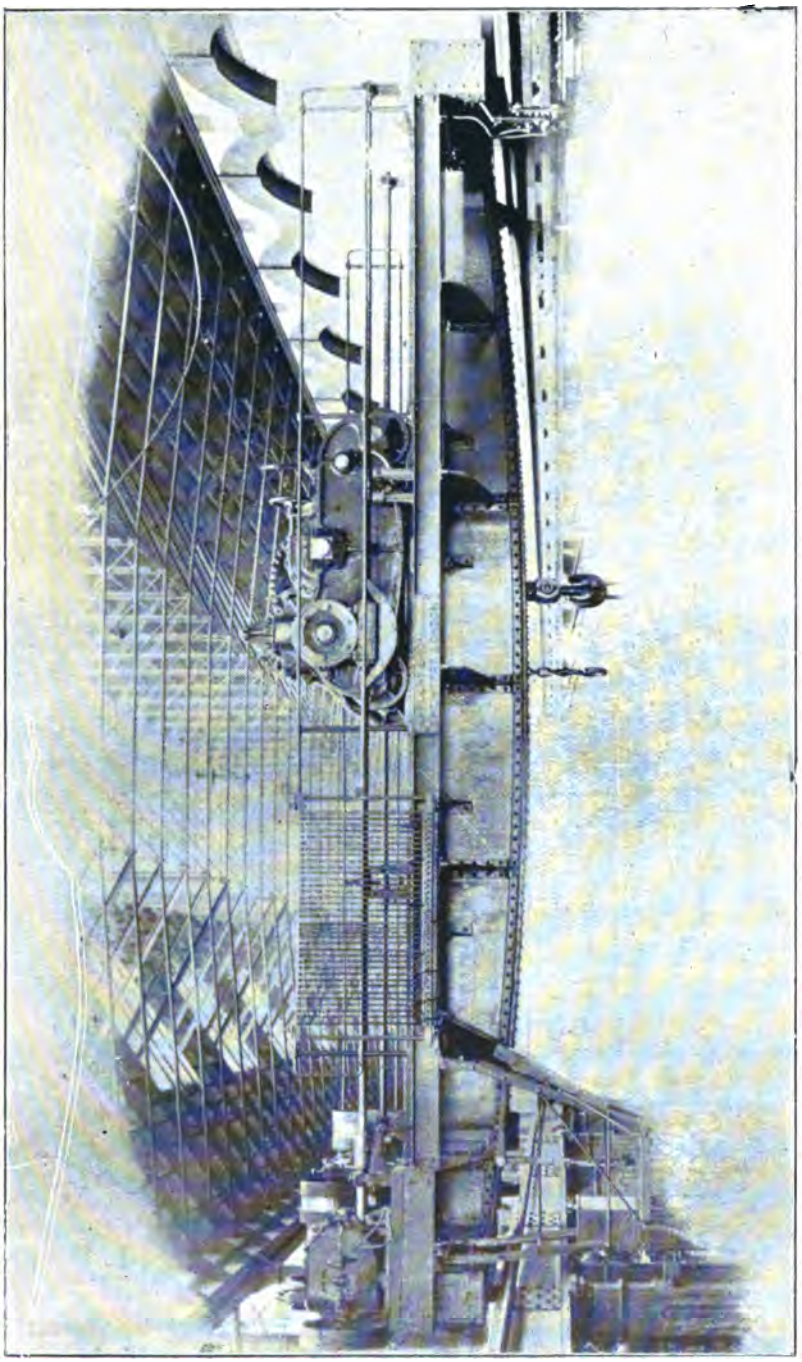


Fig. 2268

ELECTRIC OVERHEAD TRAVELLING CRANES.—The engraving Fig. 2268 is reproduced from a photograph of a crane of 30 tons power and 30 feet span constructed for service in a dynamo house. The lifting gear is double purchase, and a subsidiary barrel and chain are provided for light loads and high speed.

The girders and end cradles are of box section and are built of mild steel plates and angles with the necessary stiffening pieces. The travelling wheels have rolled steel tyres and the axles are carried in bearings secured to the end cradles and bushed with gun metal. The pinions are of cast steel.

Single web girders are generally used for cranes not exceeding about 20 tons power A subsidiary lifting barrel is rarely required for cranes of less than 15 to 20 tons power.

Driving gear.—An improved form of belt driving (the merits of which are referred to at page 114), is fixed at one end of the main beams; this gear occupies little space and affords the greatest command of floor area.

The lifting and traversing motions are transmitted by machine cut steel worms which gear with gun metal worm wheels; the worms run in oil baths attached to the sides of the crab and are provided with collars, gun metal thrust bearing, caps, &c. The chain barrel is grooved spirally and the lift is perfectly vertical. The main wheel is keyed direct on the barrel and the barrel shaft works in heavy gun metal bearings.

The electric motor.—The lifting, traversing and travelling motions are transmitted from one motor fixed near to the end of the main girders. The usual current is 100 volts but the motor is wound for a higher voltage when necessary.

The conductors are suspended from the roof and the current is picked up by a shoe, or pulley, in the usual manner.

The levers for all motions are controlled from the suspended platform shown on the left of the engraving, and appliances are provided for switching off the current when the crane is not at work.

Multiple motors.—The use of two, or of three motors is referred to in the paragraph—page 69—relating to "Electric Cranes." In some cases one motor is provided for lifting and one for travelling and traversing whilst—in others—three motors are used, of the powers requisite for the respective motions.

One or other of these arrangements may be adopted for cranes of large power, but the results obtained with the 30 tons traveller now illustrated—which is driven by one motor—are perfectly satisfactory.

The approximate prices for cranes ready to mount on the overhead gantry, include the electric motor, the switches and all electric appliances (excepting the overhead conductors which vary in length section, &c.) also the necessary driving belts, best tested chain (or flexible steel wire rope) for lifting, the side platform protected by hand rails, and the driver's platform, levers, &c.

Cranes exceeding 20 tons power usually have a second lifting barrel and chain for light loads, and two speeds for heavy loads.

PRICES OF ELECTRIC OVERHEAD TRAVELLING CRANES.

Power of crane	tons	3	5	7	10	15	20	30
Span ,, ...	feet	40	40	40	40	40	40	40
Height of lift	,,	20	20	20	20	20	20	20
Price of crane	..	£360	£440	£510	£590	£775	£950	£1200
,, per extra foot up to 50 ft.	..	£4	£6	£5	£7	£8	£9	£10
Approximate weight	tons	8	10	12	13	16	20	26

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

ALTERATIONS TO EXISTING TRAVELLERS.—Many well constructed hand and power driven cranes can be altered, with advantage to be worked by electric motors, provided that accurate drawings are supplied showing the details of the crane to be converted.

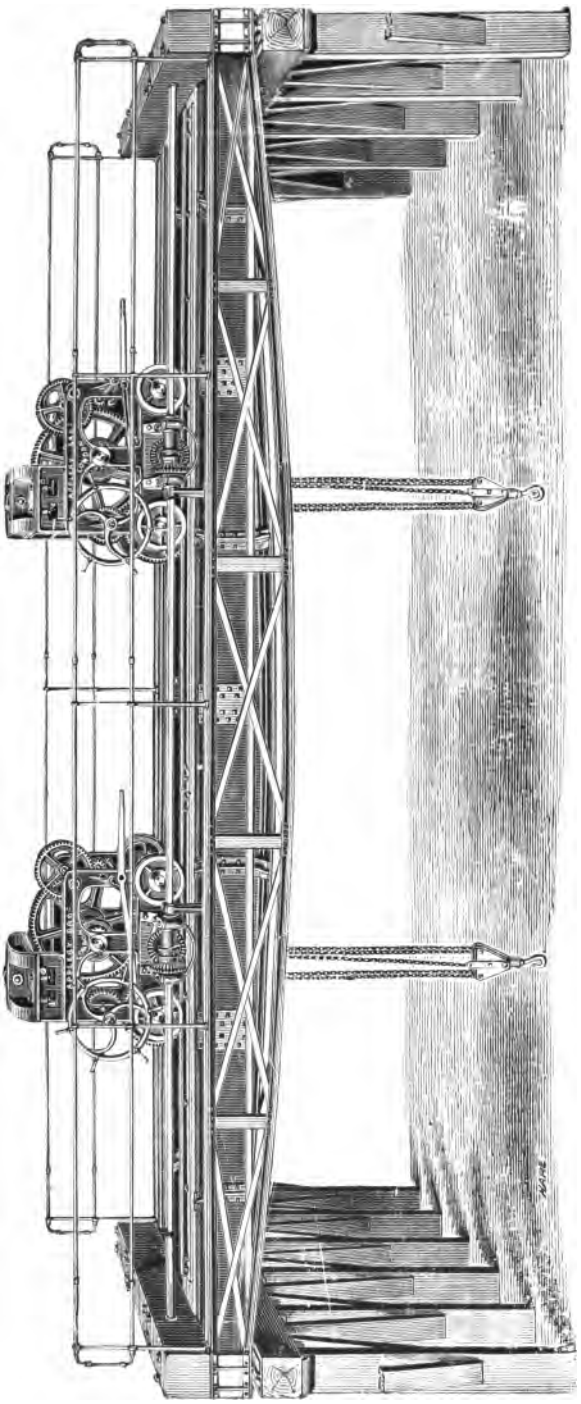


Fig. 2269

HAND POWER OVERHEAD TRAVELLING CRANES.—Fig. 2269 represents a crane of 30 tons power and 42 feet span with two crabs, each equal to a working load of 15 tons conveniently arranged for lifting and transporting moulding boxes, castings or heavy machinery, such as locomotives, marine engines, &c.

Travellers with two crabs usually range in power (collectively) from about 20 to 50 tons and are constructed to give the highest efficiency obtainable from manual labour.

Travellers with one crab to lift 20 tons, or more, are constructed as shown in the above engraving; those for lighter weights have rolled steel girders, with or without trussing.

The girders and end cradles are of mild steel with a steel rail rivetted to the upper member. The side platforms with hand rail are carried by bracket, or a light wrought iron girder as may be suitable for the span and power of the crane.

The crabs (if double) are worked separately or in combination, so that the lifting, lowering, traversing and travelling motions can be transmitted from either, or both crabs.

The prices include best tested short link lifting chain and block and all accessories ready for work when the crane is mounted on the longitudinal gantry rails.

PRICES OF HAND POWER OVERHEAD TRAVELLING CRANES, Fig. 2269.

Power of crane	tons	15	20	30	40	50
Span , ...	feet	40	40	40	40	40
Height of lift	,,	20	20	20	20	20
Price of crane with two crabs		£345	£475	£690	£885	£1035
,, ,, ,, one ,, ...		£300	£410	£600	£710	£825
Extra per foot of span, to 50 feet ..		£8	£9	£10	£12	£14
Approximate weight	tons	12	15	20	26	33

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

For travellers under 15 tons power two crabs are but seldom required and the subjoined prices are for cranes of this description, with one platform only supported from the main beam.

PRICES FOR HAND POWER TRAVELLING CRANES, WITH ONE CRAB AS Fig. 2269.

Power of crane	tons	3	4	5	10	15
Span	feet	40	40	40	40	40
Height of lift	,,	16	16	16	16	16
Price of crane	..	£125	£160	£180	£225	£280
Extra per foot of span, to 50 feet	..	£4	£5	£6	£7	£8
Approximate weight	tons	4	5	5½	8	11

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

HAND POWER CRABS AND IRONWORK FOR TRAVELLERS.—The crab is provided with single and double purchase lifting gear, strap brake and lever, longitudinal travelling motions with sleeve to take the square shaft transmitting this motion, and double flanged wheels, axles and gear for cross traversing, as well as handles or rope sheaves for all motions.

The ironwork for overhead travelling cranes comprises the tension bars and struts, as shown in Fig. 2258, travelling wheels, axles, bearings and gear for end cradles, and the rails with fastenings to fix them to timber beams provided by the purchaser.

PRICES OF CRABS AND IRONWORK FOR HAND POWER TRAVELLERS.

Power of crab	tons	3	5	10	20
Price of crab with handles		£35	£45	£55	£75
,, ,, to work from floor		£40	£52	£63	£85
,, ironwork not exceeding 40 feet span ..		£55	£75	£105	£205

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

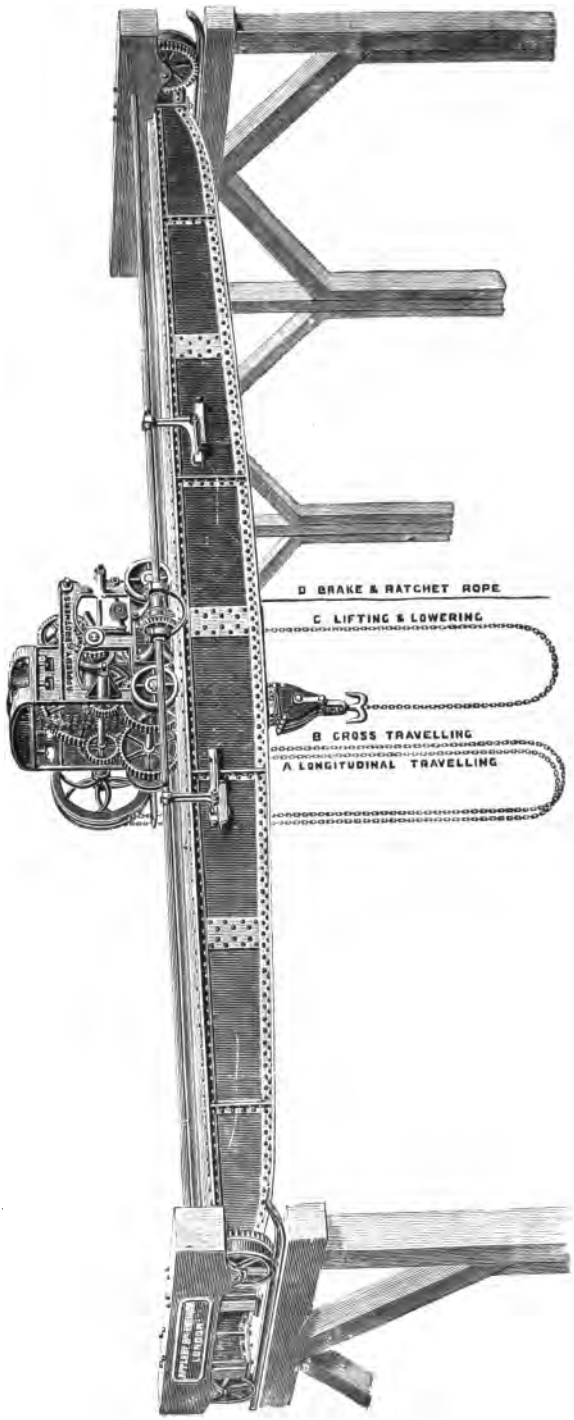

D BRAKE & RATCHET ROPE
C LIFTING & LOWERING
B CROSS TRAVELLING
A LONGITUDINAL TRAVELLING

Fig. 2270

HAND POWER OVERHEAD TRAVELLING CRANES, worked from below and constructed as shown in Fig. 2270, are rarely made of less than about 10 tons power. It is an advantage—under some circumstances—to work all motions from floor level but—in others—inconvenience may be caused by the hauling chains or ropes fouling machinery or goods whilst the crane is being traversed.

The girders and cradles are of mild steel and are complete with steel rails to carry the crab and all accessories for longitudinal and cross traverse.

The crabs and motions are as last described, hauling chains or ropes being substituted for handles.

The prices—given below—include lifting chain and block, hauling chains or ropes, as desired, and the crane is ready for work when placed on the gantry rails on which it will travel.

PRICES OF HAND POWER TRAVELLING CRANES, Fig. 2270.

Power of crane .. .. tons	10	15	20
Span ,, ... feet	40	40	40
Price of crane	£200	£260	£350
,, extra per foot of span to 50 feet	£7	£8	£9
Approximate weight	9	11	15

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

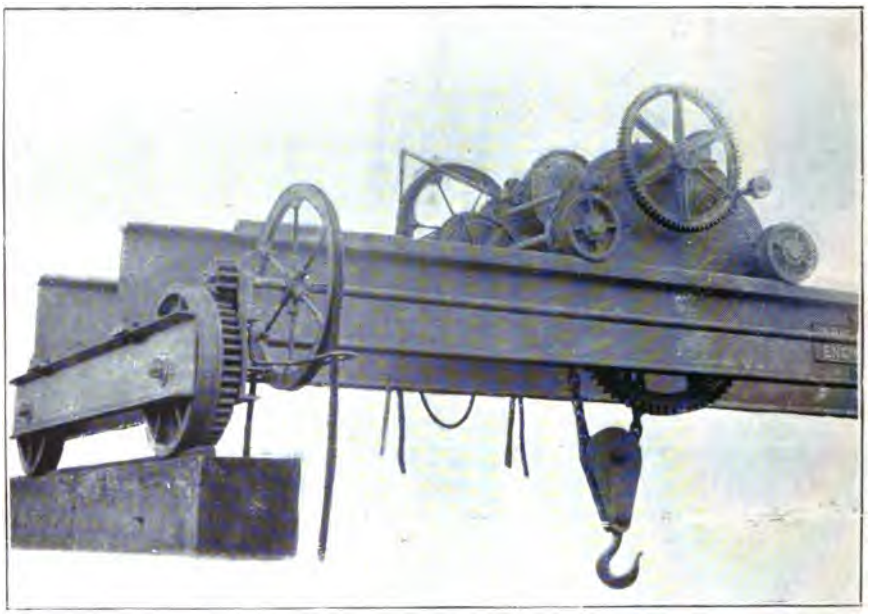


Fig. 2271.

HAND POWER OVERHEAD TRAVELLING CRANES WORKED FROM BELOW.—The engraving Fig. 2271 illustrates the construction adopted for cranes from 1 to about 15 tons power in which the undernamed valuable improvements have been introduced. These consist of:—

The very limited height above level of longitudinal travelling rails within which the cranes can be made to work when the main beams are slung under end cradles instead of supported by same as shown in Fig. 2271.

The self sustaining gear which acts automatically and holds the load suspended in case the hauling rope for lifting should be released, also

The brake for lowering the load quickly when desired.

The advantage of the self sustaining gear is obvious when erecting machinery, serving machine tools, sawing machines, piling timber &c., or for handling valuable or fragile goods. So also is that of the brake for working quickly when no special care is required.

The traveller beams and end cradles are of mild steel of the sections requisite for the maximum load. Rails for the cross traverse of the crab are rivetted to the upper members of the two main beams, and stops are provided to prevent over-running.

The longitudinal travelling motion, worked by hauling rope is, by preference, at the end, as shown, it being almost always more convenient to have a gangway along one side of the building, than elsewhere.

The cross traversing motion may be carried on the crab, as shown or, if more convenient, may be worked from the same end as the travelling motion; the extra cost of this arrangement is about 10 per cent.

The lifting motion and brake gear are easily controlled by the man in charge, and the ropes for these motions are alongside that for cross traversing.

The crab sides are made of wrought iron or mild steel; the shafts are of mild steel turned bright and the bearings are lined with anti-friction metal.

Lifting chains, &c —These are of best, best quality and are tested to Admiralty proof strain. The length is sufficient to reach to ground level and the block is provided with swivelling hook of extra best iron.

If special flexible steel wire rope is preferred the extra cost of the spirally grooved rope drum and other necessary modifications is about 10 per cent. on the prices of cranes as usually made.

The hauling ropes are of best hemp and guards are provided to prevent them leaving the grooved pulleys when carelessly handled; chains can be substituted for these ropes and are frequently found more desirable especially when they are exposed to the weather.

Cranes of 10 tons power and upwards or of extra long spans, have built up main beams similar to Fig. 2270.

Information required:—

The maximum load to be lifted.

The span centre to centre of longitudinal travelling rails.

The limit (if any) of height, above longitudinal travelling rails, within which the crane must traverse.

The total height of lift required.

If longitudinal travelling rails and girders for them are to be supplied, state the length to be traversed and the distance between supports, if these exist.

PRICES OF OVERHEAD TRAVELLING CRANES, Fig. 2271.

Power of crane	tons	1	2	3	5	7	10	15
Span of crane	feet	30	30	30	40	40	40	40
Price of crane for 15 ft. lift ..	..	£60	£80	£100	£144	£162	£180	£234
Extra per foot of span to 50 feet	..	£4	£5	£6	£6	£7	£7	£8
Approximate weight	tons	2	3	3½	5	7	9	11

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

LIGHT OVERHEAD HAND POWER TRAVELLING CRANES are frequently required for intermittent or temporary service and the undernamed have been designed to meet these conditions. The construction of the cranes so closely resembles that shown in Fig. 2271 that it is unnecessary to illustrate them by special engraving.

The girders and end cradles are of rolled steel and the motions for lifting, lowering, travelling and traversing are worked from ground level.

The cranes are complete with all accessories for a vertical lift of 15 feet and are tested with the maximum load before delivery.

PRICES OF LIGHT OVERHEAD HAND POWER TRAVELLING CRANES.

Power of crane	tons	1	2	3	5	7	10
Span ,, ...	feet	30	30	30	40	40	40
Price ,, ...		£47	£60	£90	£102	£127	£167
,, extra per foot of span to 50 ft.		£3 10 0	£4	£4 10 0	£5 10 0	£6 10 0	£7
Approximate weight		1¾	2¼	3¼	4	5	6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

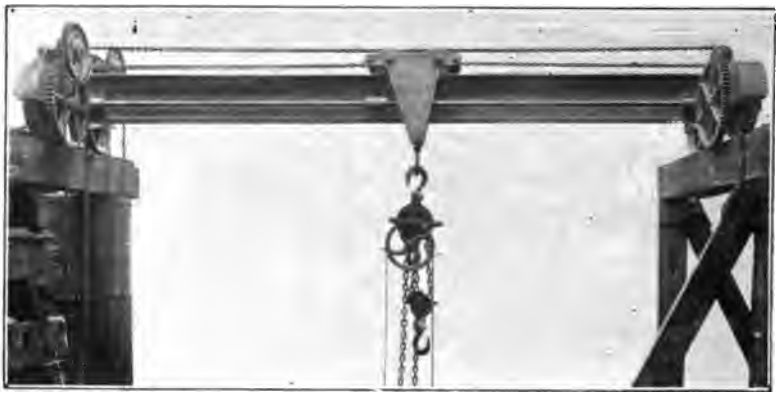


Fig. 2272.

SINGLE GIRDER OVERHEAD HAND POWER TRAVELLING CRANES of the type Fig. 2272 are much used in engine rooms, pumping, electric lighting stations, &c., firstly in erecting the machinery and subsequently in maintenance.

The main girder is of steel and is carried on cast or wrought iron end cradles fitted with double flanged wheels and gear for travelling longitudinally.

The jenney for cross traverse consists of a pair of wrought iron plates having two wheels above to run on the main beam, and a shackle or eye below from which the lifting blocks are suspended. The jenney is provided with appliances for cross traverse and this motion as well as the longitudinal travelling motion is worked by hauling chain from floor level; for 2 ton loads and under, the cross traverse motion is not necessary, as it can be easily adjusted sideways by hand.

The prices do not include blocks and chains, but the cost of these will be found on reference, respectively, to "Lifting blocks" pages 174 to 176, and "Best tested crane chain" page 182.

PRICES OF SINGLE GIRDER HAND POWER TRAVELLING CRANES, Fig. 2272.

Power of crane	tons	5	8	10	15
Span ,, ...	feet	20	20	20	20
Price ,, ...		£77	£95	£105	£137
Approximate weight	tons	2	2¾	3¼	4¼

Cost of packing for shipment and delivery f.o.b. is about 5 per cent.

FOUNDRY AND FORGE CRANES, of the construction indicated in Figs. 2276 and 2277 to work by steam, electric, hydraulic or hand power, are made with a centra post so as to be independent of top support, or with top and bottom pivot, the former being carried in a shoe which is attached to the roof or to beams provided for the purpose, as shown in Fig. 2215.

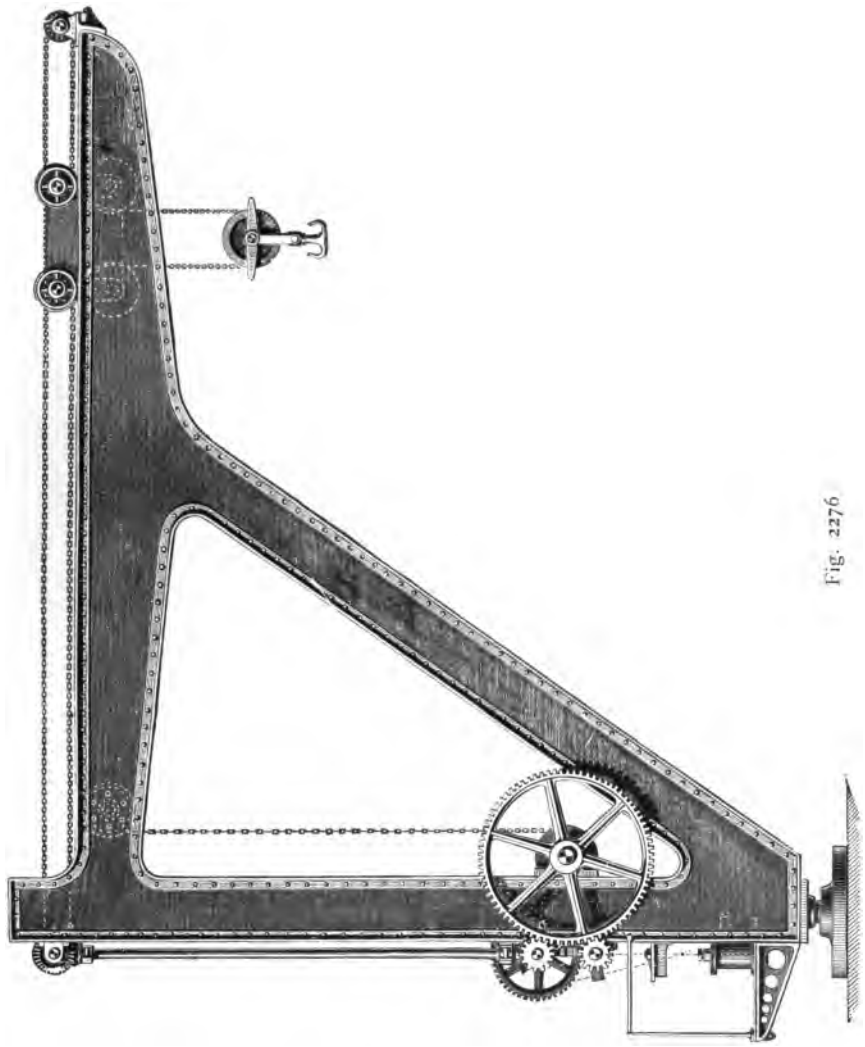
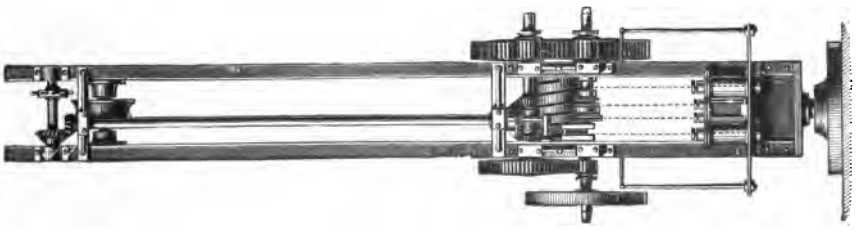


Fig. 2276



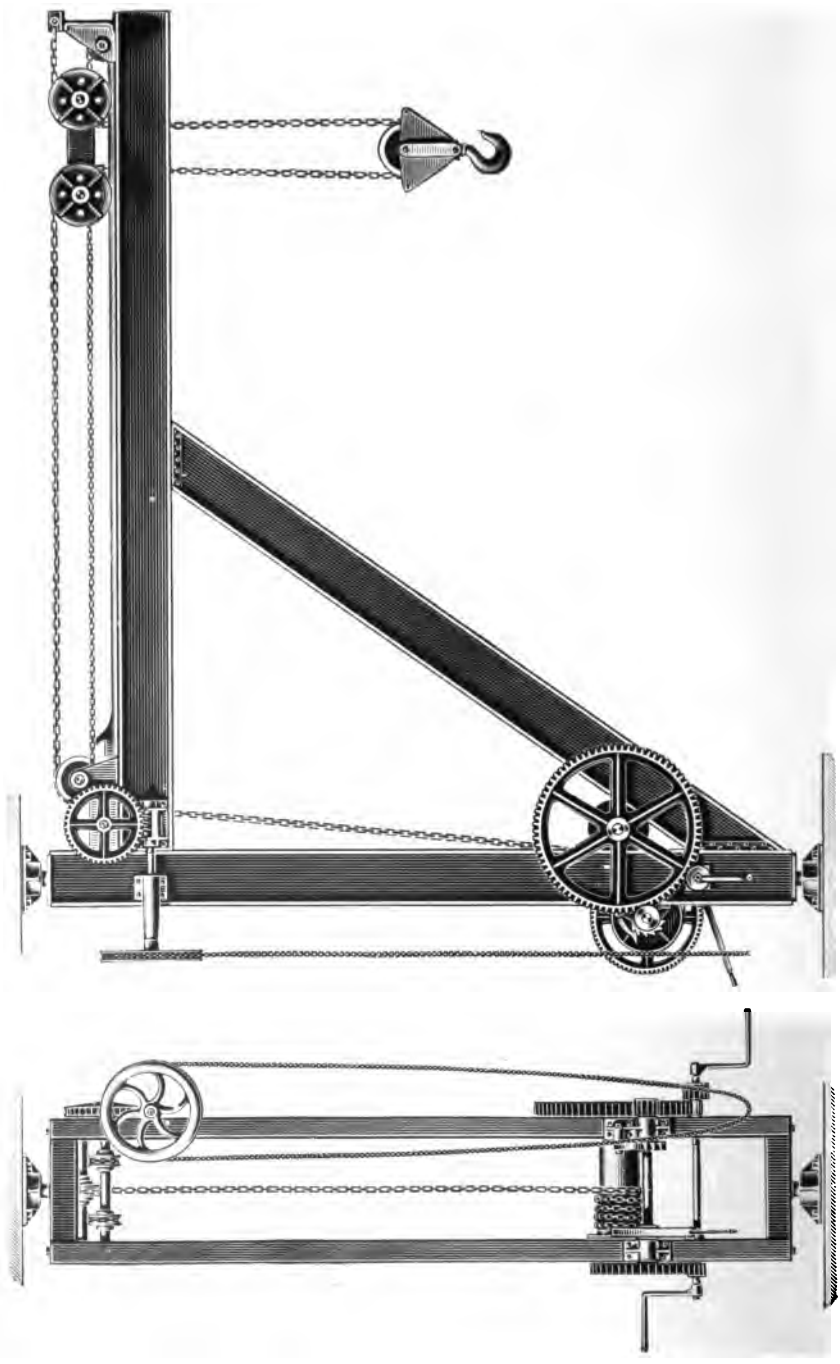


Fig. 2276A

For large foundries the preference is often given to independent cranes with central post, for the reason that an overhead travelling crane will pass over them and place materials and moulding boxes where desired, or remove castings, etc., without interfering with the work for which the foundry cranes are specially provided.

In forges a top support is usually inconvenient and frequently impossible.

Wall or column cranes of the type Fig. 2278 are usefully employed for comparatively light work in foundries or forges, by utilising space unsuitable for the heavy or bulky work. This subject is referred to under the heading "Foundry plant," at page 58 of Section VI. part **B.**

STEAM FOUNDRY OR FORGE CRANE.—The end and side elevations, Fig. 2276, represent a crane of 10 tons power and 20 feet radius with pivot (not shown) for top support, but the same arrangement is carried out for independent cranes with central post.

The side frames and jib are constructed of plates and angles or of rolled steel sections as illustrated respectively in Figs. 2276 and 2276A. The vertical members are cross braced where necessary and connected at top and bottom by strong castings with turned steel pivots, one of them being bored and fitted with connections for conducting steam to the engines or electric current to a motor, as the case may be. The foundation plate, with spur ring as indicated in Fig. 2277, is bored to receive the bottom pivot, and power for slewing is transmitted from the engine or motor; the bearing for the top support is fixed as shown in Fig. 2214 or in other convenient manner. The outer ends of the jib girders are connected by a casting and the jenney is traversed by pitch chain or shaft and worm gear as desirable.

The machinery consists of a pair of engines with case-hardened, link-reversing motions, single and double purchase lifting gear and all appliances for jenneying and slewing; the levers which control each motion are worked from the driver's platform at the base of the mast. The foot plate can be extended to carry a boiler, but this is rarely necessary or desirable.

PRICES OF STEAM FOUNDRY OR FORGE CRANES WITH TOP SUPPORT.

Power of crane .. .. .. tons	1½	2	2½	3	5	10	15
Radius of jib .. .. .. feet	13	14	15	16	18	20	20
Height from floor .. .. ,,	11	11½	12	12	13½	15	15
Price of crane, rivetted frames, Fig. 2276	£110	£125	£140	£160	£230	£365	£480
,, rolled sections, Fig. 2276A	£100	£115	£125	£140	£200	£320	£420

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

INDEPENDENT STEAM FORGE OR FOUNDRY CRANES of the construction above described, are carried on a forged iron or steel post of the requisite length and section keyed in a massive foundation plate, requiring no top support. This increases the cost to the extent indicated below.

PRICES OF INDEPENDENT STEAM FOUNDRY OR FORGE CRANES WITH POST.

Power of crane .. .. .. tons	1½	2	2½	3	5	10	15
Radius of jib .. .. .. feet	13	14	15	16	18	20	20
Height from floor .. .. ,,	11	11½	12	12	13½	15	15
Price of crane, rivetted frames as Fig. 2276	£165	£175	£190	£210	£295	£405	£685
,, rolled sections as Fig. 2276A	£155	£168	£178	£190	£268	£458	£625

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

ELECTRIC FOUNDRY OR FORGE CRANES.—The general arrangement is as illustrated in Figs. 2276 to 2277, but an electric motor is substituted for the engines, and the gear is modified to suit the higher speed of the motor.

The price of an electric crane is rather higher than that of a steam crane of equal proportions and power; but taking into account the conductors and accessories requisite in each case, the difference in the total cost is quite unimportant.

POWER DRIVEN FOUNDRY OR FORGE CRANES are always specially designed to suit the mode of driving, the proportions, etc. required.

HAND-POWER FOUNDRY or FORGE CRANES with rivetted side frames (see Fig. 2276) or built of rolled steel sections, as illustrated in Fig. 2276A, complete with lifting and racking motions, chains, block with swivel hook, and handles are constructed for top support or independent thereof, at the following approximate prices :—

PRICES OF HAND-POWER FOUNDRY OR FORGE CRANES, TYPES FIGS. 2276 & 2276A.

Power of crane .. .. .. tons	1½	2	2½	3	5	10	15
Radius of jib .. .. .. feet	13	14	15	16	18	20	20
Height from floor .. .. .. ,,	11	11½	12	12	13½	15	15
Price of crane, rivetted frame as fig. 2276	£70	£80	£95	£115	£160	£285	£400
,, rolled section as fig 2276A	£60	£72	£82	£100	£140	£250	£350
,, fig. 2276 with post ..	£125	£135	£145	£165	£230	£425	£600
,, fig. 2276A ,, ..	£110	£120	£130	£150	£208	£388	£555
Extra for slewing motion	£7	£8	£9	£9	£10	£16	£18

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

STEAM FOUNDRY OR FORGE CRANE WITH CURVED JIB.—The range of traverse (owing to the clear space under the jib) which is gained by the construction shown in Fig. 2277, is generally desirable and was essential in the foundry for which these cranes were built ; they are carried on a central post and are independent of top support.

The engines, driver's platform, etc., are as shown in Fig. 2276 and the crane is complete with gear and accessories similar to those already described.

For prices of cranes constructed on this principle 20 per cent. must be added to the prices on page 127 for independent steam cranes, Fig. 2276.

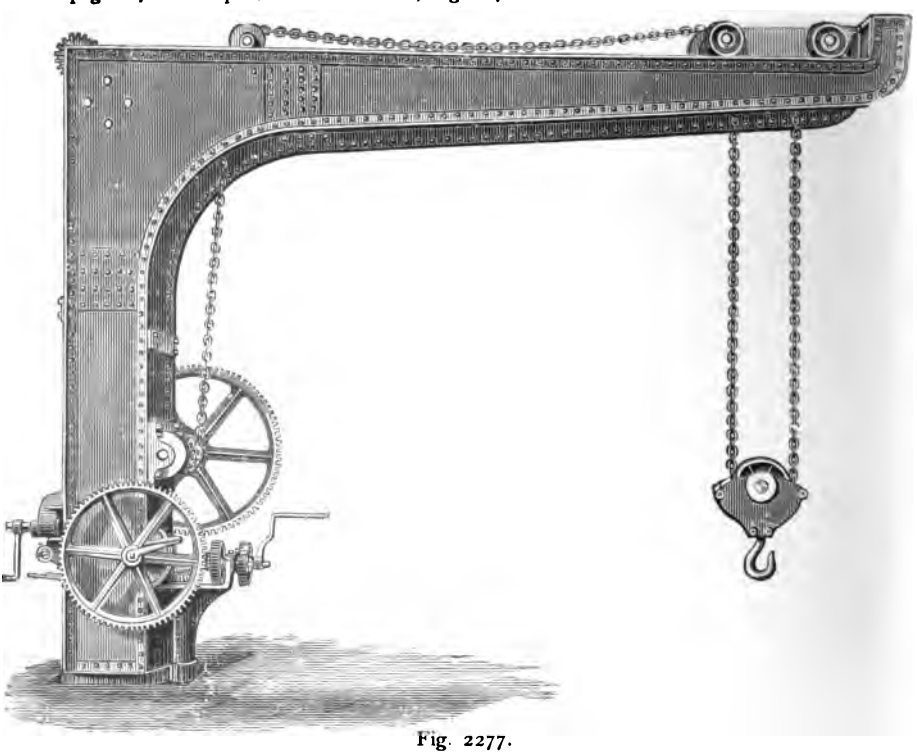


Fig. 2277.

HAND POWER FOUNDRY OR FORGE CRANE WITH CURVED JIB.

Fig. 2277 represents a crane of 10 tons power 16 feet radius with a clear height of 16 feet under the jib.

The side frames are of wrought iron plate with angle iron frames and bracings and bottom and top castings bored for the wrought iron post around which the crane rotates.

The lifting and slewing motions are single and double purchase and all appliances are provided for an exceptionally long traverse of the jenney from which the load is suspended. The chain barrel is grooved spirally and the crane is complete with best tested lifting chain and block and handles for all motions.

PRICES OF HAND POWER CURVED JIB FOUNDRY OR FORGE CRANE, Fig. 2277.

Power of crane	tons	3	5	10	15
Radius of jib	feet	16	18	20	20
Height ,, ...	,,	12	13½	15	15
Price of crane with top support ...	...	£120	£168	£300	£420
,, ,, post	...	£170	£236	£438	£625

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

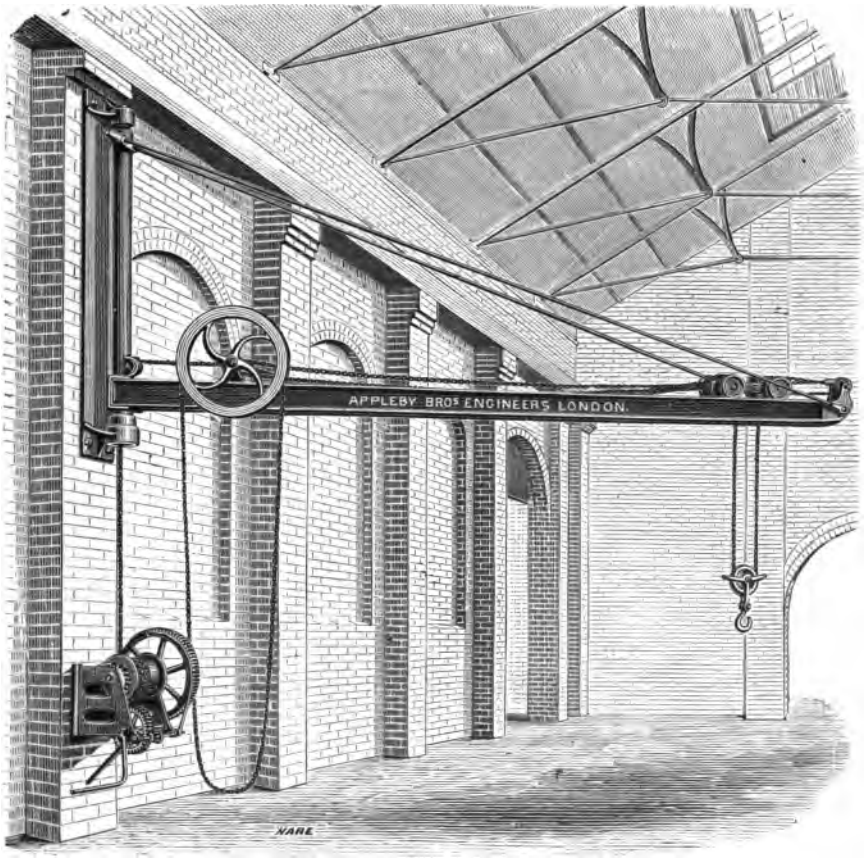


Fig. 2278

WALL OR COLUMN CRANES of the type Fig. 2278 are arranged to work by steam, electric, hydraulic or hand power and are usefully employed in foundries and in smith's and boiler shops for handling forgings, wrought iron work for hydraulic rivetting machines, &c.

The foundry represented in the engraving is equipped with these cranes, worked by hand power, and with an overhead crane of 15 tons power (not shown), which travels on the longitudinal beams above the wall cranes and commands the whole area of the foundry, without interfering with the working of cranes below.

The jib consists of a pair of steel girders connected to the bottom of the vertical post, the outer ends being carried by tie bars, as shown. The back plate is provided with bearings in which the crane swings quite freely.

The lifting gear is fixed, where convenient, below the crane; the height of lift being limited, a hand power winch usually answers every purpose.

The winch illustrated has single and double purchase gear, ratchet wheel on the end of the chain barrel and wrought iron pawl, strap brake and lever.

The jenney is traversed by chains attached to each end of the carriage and motion is transmitted by the grooved pulley and hauling chain.

The prices include the jib with back plate and ties, jenney gear, hand winch and handles, best tested lifting chain and block with swivel hook.

PRICES OF WALL OR COLUMN CRANES, Fig. 2278.

Power of crane .. .. tons	1	2	3
Radius of jib .. .. feet	16	16	18
Price of crane	£60	£75	£105
Approximate weight .. .. tons	2	2½	3

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

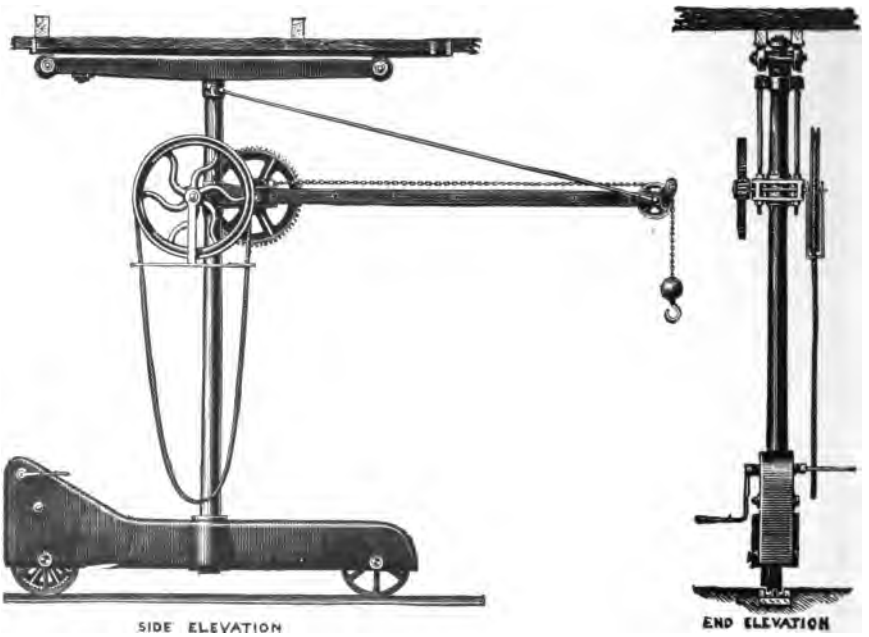


Fig. 2279

SINGLE RAIL CRANES are arranged to work by endless cotton cord, by electric motor, or by hand power as indicated in Fig, 2279 Power driven cranes must always be specially designed.

The limited floor space occupied by the undercarriage, and the facilities afforded by the lifting, rotating and travelling motions, render these cranes peculiarly useful for serving lathes.

or other tools on each side of the line traversed, and almost equally so in erecting shops, warehouses, &c., for travelling with the load and depositing it to the right or left of the crane track or of a line of columns to which the top guides are attached.

The hand power single rail crane, Fig. 2279, is of 1 ton power, the height of post is 13½ feet and the radius of the jib 12 feet, the clear height below it being about 10 feet.

The undercarriage and post is fitted with double flanged wheels, fore and aft, and gear for travelling the crane, the rail is usually flush with the floor and offers no obstruction to cross traffic.

The crane post is of mild steel and is keyed in the undercarriage. A horizontal roller at the top works between timber or wrought iron guides which are fixed to an upper floor, or beams, as indicated in the end elevation. This maintains the crane in a vertical position and a pair of bars, with rollers at each end bearing on the guides, prevent the crane from tipping and reduce friction in travelling.

The lifting gear is attached to the jib and is worked by hauling on the endless chain or rope. The lifting chain barrel is provided with self sustaining appliances which operate automatically when hauling ceases. A pair of rollers work against the crane post and minimise friction in slewing.

The cranes are built to suit the height between floor and top supports and for the radius and clear height required; they are complete with lifting chain and hook, hauling rope and guide, handles for travelling, &c.

PRICES OF HAND POWER SINGLE RAIL CRANES, Fig. 2279.

Power of crane .. .. tons	½	1	1½	2
Radius of jib .. .. feet	10	12	12	12
Clear height of jib .. .. ,,	10½	12	12	13
Price of crane	£70	£75	£85	£100
Approximate weight .. . . tons	2	2½	3	4

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

SHEAR LEGS OR MASTING SHEARS.—Although shear legs are to some extent superseded by powerful cranes which make a complete revolution, or by derrick cranes, they are still almost indispensible for the equipment of vessels with their engines, boilers and heavy armaments.

Some modifications made since the shear legs Fig. 2280 were built, are referred to below, but the essential features of a pair of masts, each pivoting in a massive shoe fixed to the quay, and provided with appliances for adjusting the rake of the masts, remain unchanged.

They are worked by steam, hydraulic, electric or manual power, and are built to fulfil almost any conditions in regard to height, reach and lifting capacity.

Steam power shear legs to lift 60 tons are represented in Fig. 2280. The height of the masts is 90 feet and the length of the back leg for regulating the angle of the masts is 120 feet. There are two sets of chain sheaves and lifting blocks, one for the maximum duty and the other (not shown) for loads up to about 10 tons. The lifting chains are led back to the steam winch barrels which have speeds respectively of about 2 feet 6 inches, and 12 feet per minute.

The rake of the masts is adjusted by traversing the winch gear and the slide block on the lower end of the back leg, in the guides shown in the engraving; but this motion is now usually worked by a strong screw and heavy gun metal nut.

The cost of the shear legs with wrought iron tubular masts and back leg, machinery, engines and boiler, chains, blocks, &c. is about .. .. £3000.
The approximate weight is 100 tons.

Steam machinery for shear legs of 75 tons power. A successful alteration made by the writer's firm has converted a shear legs worked by hand power; the racking motion is controlled by steel wire rope in lieu of the back leg shown in Fig. 2280, and all operations are performed by steam

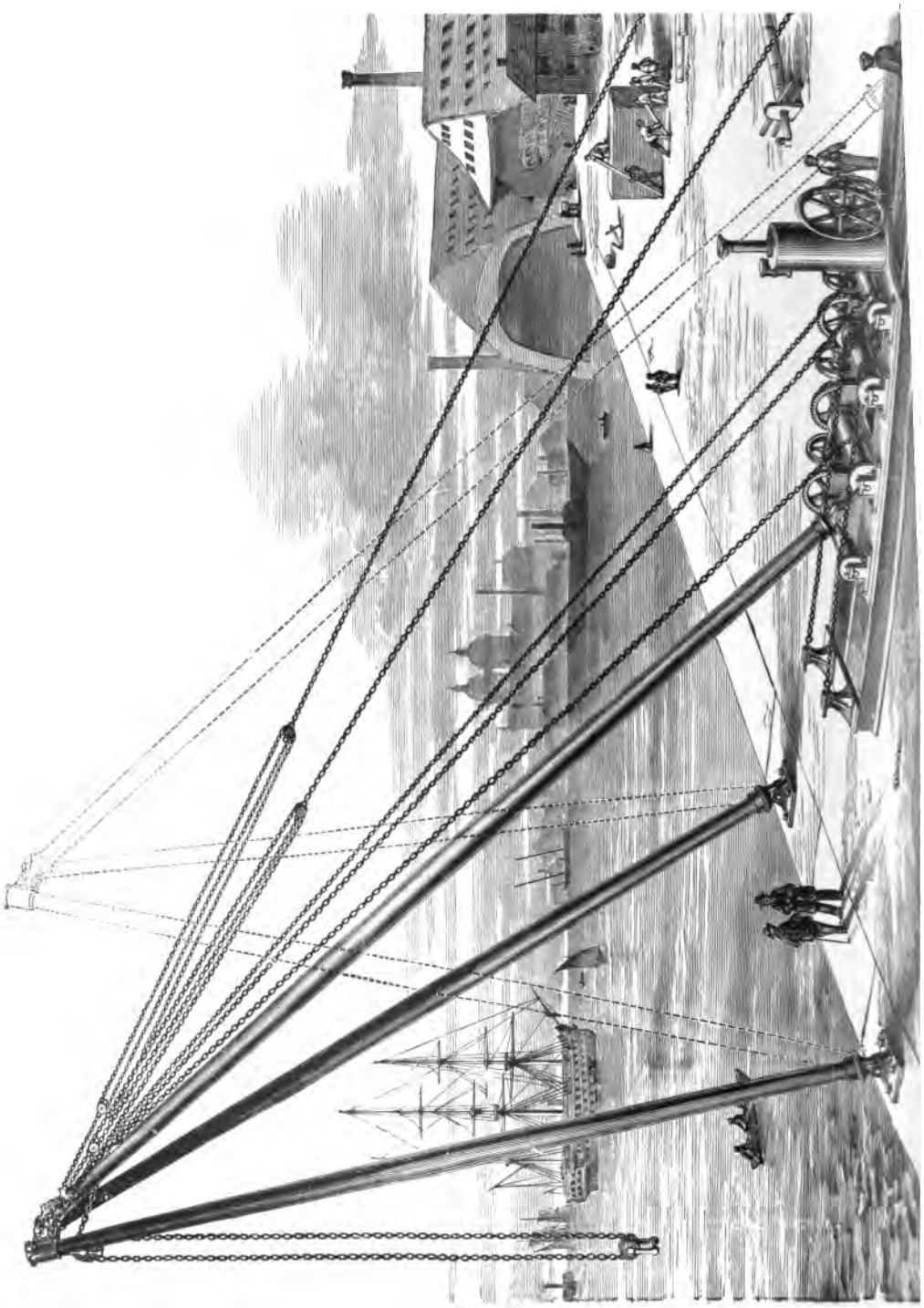


Fig. 2280

The machinery consists of a powerful steam winch with horizontal engines and link motion reversing gear. The main rope barrel is driven by a steel worm gearing with a steel wheel, and the purchases are arranged to lift the maximum load at a speed of 2 feet per minute, and 30 tons at 6 feet per minute, in both cases, over the blocks between the masts. A second rope barrel driven by spur gear lifts up to 10 tons at a speed of 12 feet per minute, over the subsidiary block provided for that purpose. This barrel can be disconnected from the shaft, by a clutch, and the load is sustained, or lowered, by a brake. The ends of the shaft are provided with drums which are then available for coiling the guy ropes by which the rake of the masts is regulated.

The cost of the machinery without boiler (steam being supplied from an adjacent boiler), including about 100 feet of flexible steel wire lifting and guy ropes is about £575.

The approximate weight is nine tons.

Including boiler and fittings, top sheave, spindle and bearings, and lifting block with live ring swivelling hook, the price is about .. .. £900.

Without racking motion, but otherwise as above, the price is about .. £800.

Hand power shear legs to lift 30 tons with masts in timber 45 feet high and a maximum rake of about 25 feet, have been built for handling locomotives and heavy machinery.

The winch has wrought iron frames with barrels and gear for 30 and 10 tons, and for derricking the masts. It is fixed on wrought iron girders and is complete with brakes and all accessories.

The cost of the shears with hand power winch, chains, sheaves and blocks is about .. .. £900, and the weight is about 35 tons. If with steam winch, boiler and connections the cost is about .. .. £1,150.

The cost of the machinery, iron work and chains ready to erect at destination is about .. .. £700. If with steam winch, boiler, &c., the cost is about .. .. £950.

The usual charges for packing and delivery f.o.b. (probably about 5 per cent.) should be added to all the above prices.

TRIPOD HAND POWER SHEAR LEGS consist of a set of three timber legs, united at the top by a bolt passing through them and carrying a loop from which the lifting block is suspended.

The winch is attached to a double back leg with stretcher bar, and is complete with ratchet and pawl, handles, &c.

The prices are respectively for the Tripod with pitch pine legs (exclusive of lifting chain or rope), and for the winch, lifting blocks and top caps, ready to fix on timber legs provided at destination.

PRICES OF HAND POWER TRIPOD SHEAR LEGS.

Lifting power .. .. tons	1	2	3	5
Price with timber legs	£10	£12	£14	£18
,, of ironwork only	£6	£7	£8	£10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

WINDING AND HAULING ENGINES.

The two types of winding and hauling machinery in general use and referred to in the following pages, are known, respectively, as "direct acting" and "geared" engines.

Direct acting engines, whether arranged horizontally as indicated in Fig. 2281, or vertically, have the drums keyed on the engine shaft and are almost invariably designed to fulfil clearly defined conditions in regard to the length of rope to be coiled, speed of winding, maximum loads, &c.

For deep coal (and some metalliferous) mines, the "scroll drum" is frequently adopted with a view to maintaining (approximately) equal duty throughout the wind, but these and other combinations to obtain the highest possible efficiency vary too widely to be tabulated.

Geared winding engines have the rope drums, brakes and spur wheel on a separate shaft, driven by a pinion on the engine shaft as illustrated in the engravings, Fig. 2282 to 2292, or by belt, wire rope or other transmission of power.

This construction admits of almost endless variation in power and speed and no system of winding or hauling machinery is so favourable to division of parts—all practically undamageable—for transport.

Lifting and hauling power.—The following figures are based on a speed of rope of 500 feet per minute and furnish the data for calculating the duty attainable with other speeds loads and gradients.

The steam pressure is assumed to be not less than 80lbs. per square inch (about 5½ atmospheres).

Nominal horse power of engine	4	8	12	16	20	25	32	40
Effective ,, ,, ...	10	20	30	40	50	60	80	100
Weight lifted virtically .. .. cwts.	7	13	19	25	31	37	47	57
,, hauled on level .. .. ,,	405	728	1063	1400	1736	2083	2628	3192
,, ,, up 1 in 20 (5%) .. ,,	122	216	325	412	514	616	777	972
,, ,, 1 in 10 (10%).. ,,	66	115	175	220	277	332	418	523
,, ,, 1 in 5 (20%) .. ,,	34	60	90	115	144	172	217	272

The pumping arm shown in some of the engravings (and mentioned with other accessories) serves to work the drainage pumps between lifts or at any other time. Moderate quantities of water are, however, often mastered by skips; or if the inflow is heavy and persistent, a skip which fills and empties automatically is suspended below the winding cage and so raises the water accumulated at every lift or between lifts.

The prices of pump quadrants and mine pumps will be found at pages 39 and 40 of Section VI. and Section III.

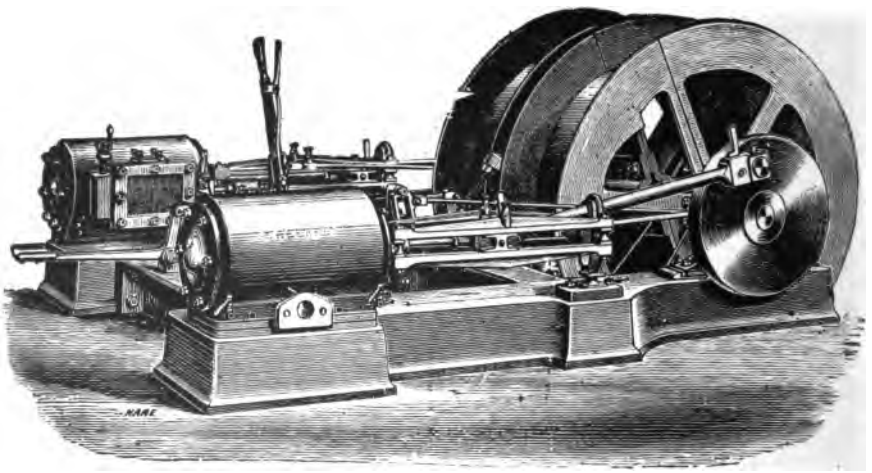


Fig. 2281.

Direct acting winding engines.—Fig. 2281 represents a compact arrangement of engines for high speed winding. They are fitted with case hardened link reversing gear, steel piston and valve rods, and the guides are as shown in this engraving or in Fig. 2284, as may be desirable.

It will be understood that the speed of winding is completely controlled by the driver.

The prices include a locomotive or Cornish boiler with fittings and usual connections, powerful brake and all accessories for efficiency in working, and will serve as a basis for approximately estimating the cost of winding plant of moderate power.

PRICES OF DIRECT ACTING WINDING ENGINES, Fig. 2281.

Nominal horse power	20	30	40	50
Effective ,, ...	50	75	100	125
Winding speed per minute .. .. .. feet	1000	1000	1000	1000
Gross load .. .. tons	½	1	1½	1½
Price of engine and boiler	£580	£720	£900	£995

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

GEARED WINDING ENGINES.—The following description relates to several sets of winding plant which are raising 500 to 600 tons of coal per day, from depths of 300 to about 500 feet.

The engines are horizontal, with the winding drums between them, as indicated in Fig. 2281. The steam cylinders are 24 inches diameter by 48 inches stroke secured to heavy cast iron beds, and the valves are balanced. The link reversing motions are case-hardened ; the piston and valve rods are of steel, and the weight of the piston is carried by a slipper guide behind the back cover of the cylinder.

The working parts are carefully balanced and finished in the manner requisite to ensure economy in maintenance.

The levers controlling all motions are conveniently arranged and the steam pipes are below the engine room floor, or overhead, as may be convenient.

Winding gear.—The two rope drums (for up cast and down cast) taper in diameter from 11 feet to 12 feet ; the length of each drum is 5 feet 3 inches between flanges and they are driven by a pinion on the crank shaft gearing with a spur wheel on the drum shaft. The brakes are worked by foot lever and are of ample power for any emergency.

The cost of the plant including the engines and three Cornish boilers, one being always in reserve, steam pipe and fittings, winding indicator for each drum and the usual tools for the engine room is about .. .. £2000.

Geared Winding engines of the undernamed dimensions are constructed as above described, but the drums are frequently made to run loose on the shaft.

The following prices include the steam pipes and steam valves between cylinders but not those to connect with boilers.

PRICES OF GEARED WINDING ENGINES.

Nominal horse power	10	14	16	20	25	30
Effective ,, with 80 lbs. steam ..	25	35	40	50	65	75
Diameter of drums .. .. .. inches	54	54	60	60	60	60
Price of engine with fixed drum	£365	£395	£435	£480	£560	£600
,, ,, ,, loose drum	£377	£407	£447	£492	£575	£615
,, ,, ,, two drums and clutches..	£410	£445	£495	£540	£625	£670
,, winding indicator, each drum ..	£12	£12	£12	£13	£14	£14
,, cast steel gear	£20	£22	£25	£27	£30	£32
,, pumping arm	£10	£11	£12	£12	£12	£13

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

GEARED WINDING AND PUMPING ENGINES.—The conditions fulfilled by the machinery shown in side elevation, Fig. 2282, and end elevation and plan, Fig. 2283, so frequently occur that they are briefly described, although reference to some portions of the plant will be found in Section III which treats more especially of pumping machinery.

The machinery illustrated lifts 1 ton at 350 feet per minute and drains the mine (silver lead) to a depth of 380 feet, the pumps being provided with sliding suction to follow the sinking which is of the strength to resist the effects of blasting.

It has been in every sense satisfactory, but if sectional boilers, steel pump pipes, and engines with steel frames as illustrated by Fig. 2289 and had been in existence when the plant now described was built, probably the designs would have been modified ; but the difficulties in transport from the port to the mines were provided for by sending (with the machinery) a strong broad wheeled trolley for bullock traction.

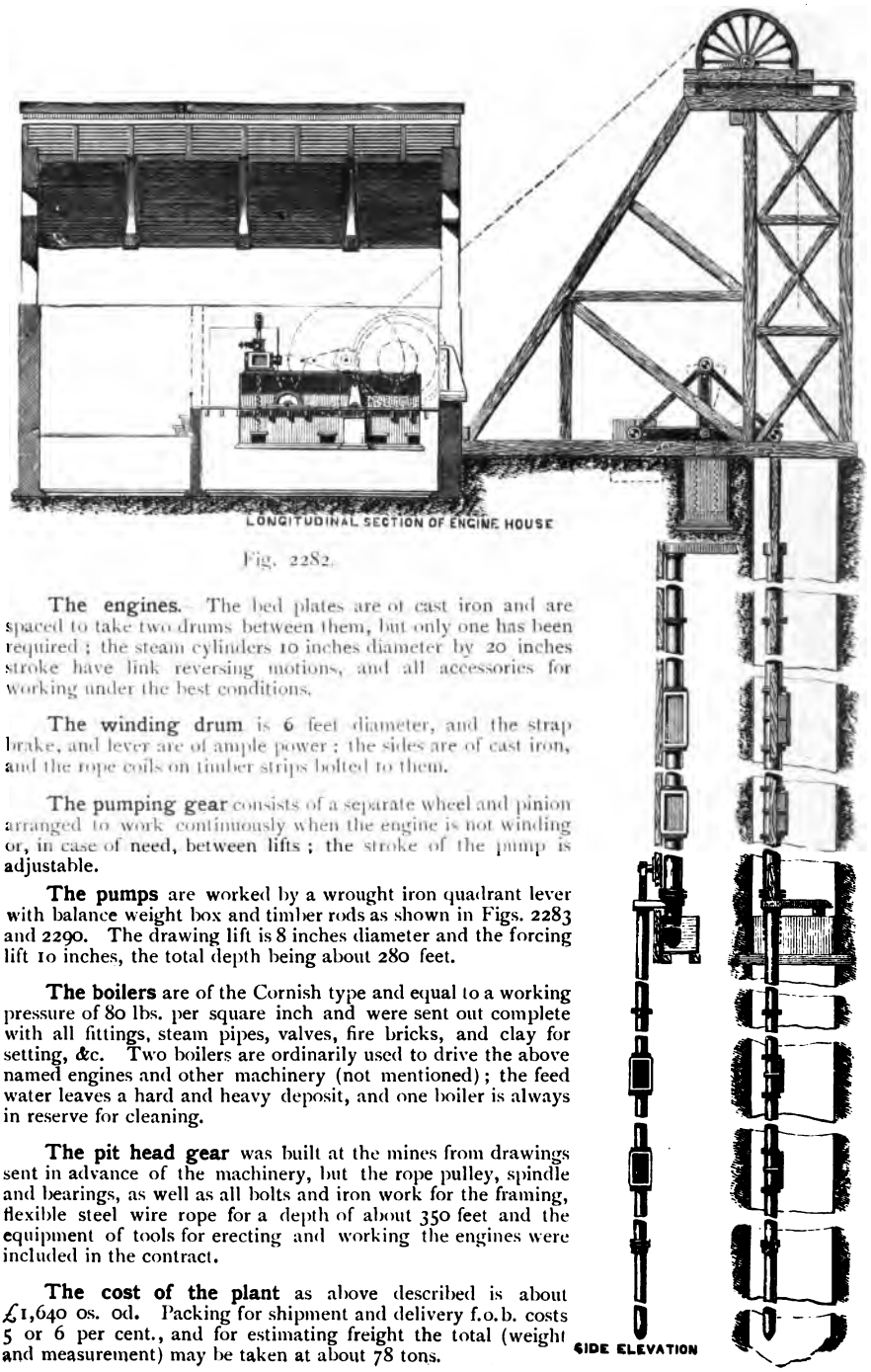


Fig. 2282.

The engines. The bed plates are of cast iron and are spaced to take two drums between them, but only one has been required; the steam cylinders 10 inches diameter by 20 inches stroke have link reversing motions, and all accessories for working under the best conditions.

The winding drum is 6 feet diameter, and the strap brake, and lever are of ample power: the sides are of cast iron, and the rope coils on timber strips bolted to them.

The pumping gear consists of a separate wheel and pinion arranged to work continuously when the engine is not winding or, in case of need, between lifts; the stroke of the pump is adjustable.

The pumps are worked by a wrought iron quadrant lever with balance weight box and timber rods as shown in Figs. 2283 and 2290. The drawing lift is 8 inches diameter and the forcing lift 10 inches, the total depth being about 280 feet.

The boilers are of the Cornish type and equal to a working pressure of 80 lbs. per square inch and were sent out complete with all fittings, steam pipes, valves, fire bricks, and clay for setting, &c. Two boilers are ordinarily used to drive the above named engines and other machinery (not mentioned); the feed water leaves a hard and heavy deposit, and one boiler is always in reserve for cleaning.

The pit head gear was built at the mines from drawings sent in advance of the machinery, but the rope pulley, spindle and bearings, as well as all bolts and iron work for the framing, flexible steel wire rope for a depth of about 350 feet and the equipment of tools for erecting and working the engines were included in the contract.

The cost of the plant as above described is about £1,640 0s. 0d. Packing for shipment and delivery f.o.b. costs 5 or 6 per cent., and for estimating freight the total (weight and measurement) may be taken at about 78 tons.

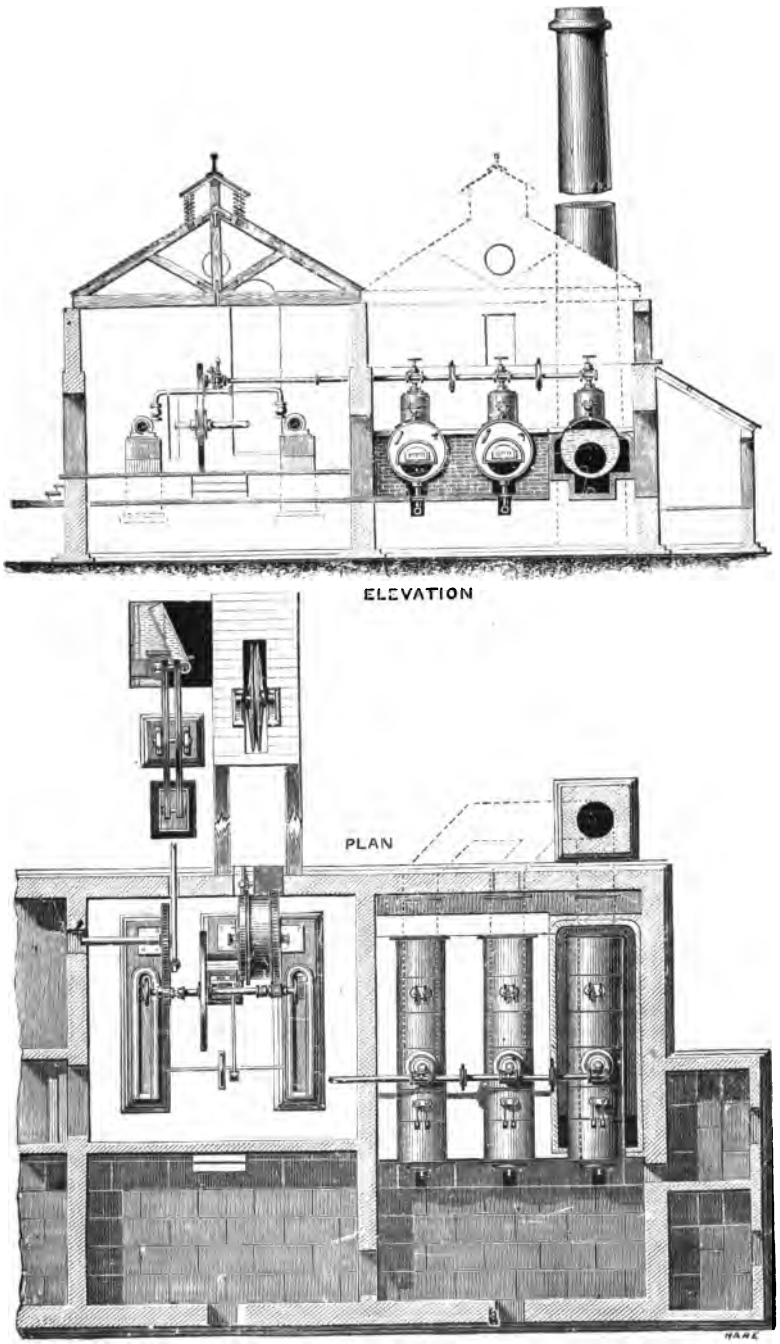


Fig. 2283

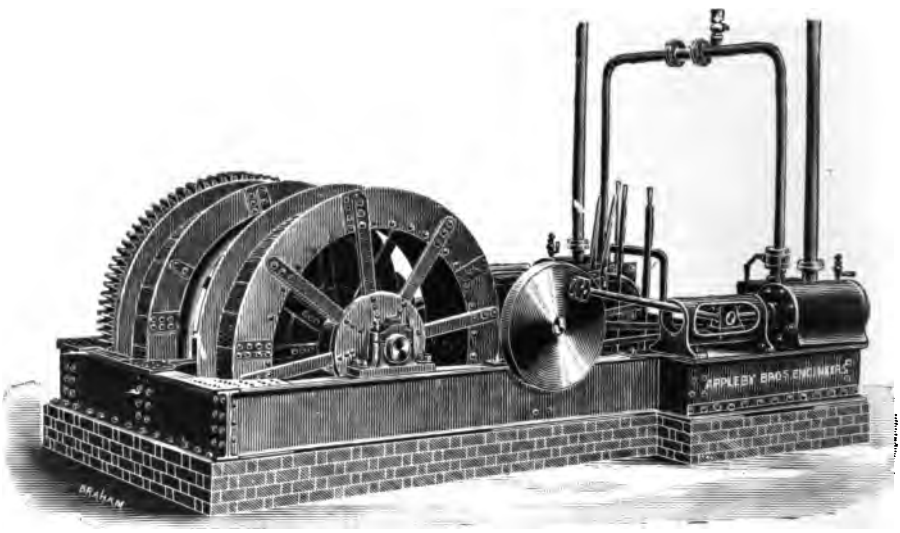


Fig. 2284.

WINDING OR HAULING ENGINES WITH STEEL FRAMES.—Fig. 2284, shews a type of horizontal winding gear, specially adapted for use in localities where lightness of parts is neccessary owing to difficulties of transport. To attain this object the frames are built up in wrought-iron or mild steel, so that the weight and bulk of parts may be reduced to a minimum, these being properly marked for re-erection at destination.

Where the conditions above referred to do not exist, the engines and gear are mounted on a massive cast-iron bed plate. This reduces the cost from 5 to 10 per cent., but the construction indicated above is almost invariably preferred.

As will be seen in the engraving the arrangement is compact, all parts are accessible for examination or repair, and the levers are conveniently placed, the brake lever (not shown) being generally carried behind the cylinders. The engines are carefully balanced and fitted with case-hardened reversing link motion, and all working parts are thoroughly well fitted and finished.

The double drums are loose on shaft, the clutch of each drum being fitted with a separate lever, so that they may be worked independently or together ; the drums are usually made of two cast-iron cheeks with wood lagging, but where lightness of parts is neccessary, they are made of wrought iron as shewn in Fig. 2284.

The boilers referred to in the list of prices are of the locomotive type, represented in Fig. 2289, and are complete with chimney, and all fittings for steam and feed water, as well as the furnace mountings, and pipe connection for a moderate distance between the boiler and engine.

PRICES OF WINDING AND HAULING ENGINE, Fig. 2284.

Nominal horse power	6	10	16	25
Effective ,, ...	15	25	40	65
Price of long type engine	£190	£250	£315	£405
,, short ,, ...	£165	£215	£270	£330
,, cast steel gear	£10	£19	£30	£37
,, wrought iron drums	£22	£28	£36	£37
,, pumping arm	£9	£9	£10	£12
,, winding indicator, each drum	£12	£12	£12	£12
,, Boiler and connections	£85	£110	£155	£250
,, Injector and fittings	£8	£8	£10	£10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

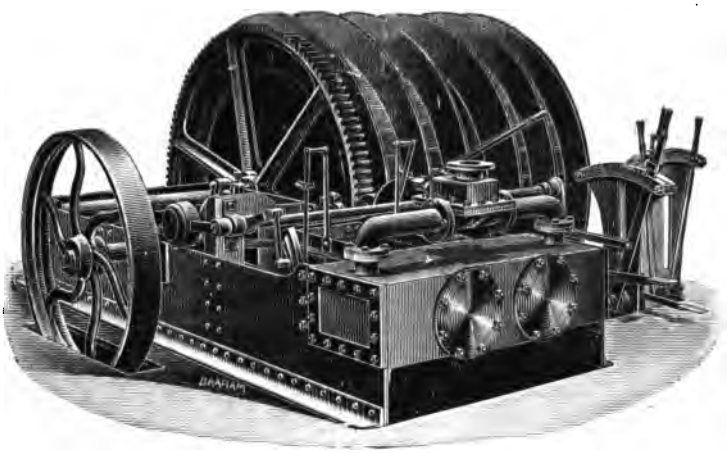


Fig. 2285.

SIDE DRUM GEARED WINDING ENGINES.—Fig. 2285 illustrates an engine of 35 effective horse power built for a South African Mine where the cost of transport from the port to the mines far exceeded the cost of machinery as packed for shipment.

The engines and motion gear are carried in a strong steel frame, sub-divided for transit and marked for re-erection.

Each pair of winding drums is loose on the shaft which is supported by a pedestal bearing at the outer end, the inner end being carried in a bearing secured to the engine frame. The drums are 6 feet diameter by about 12 inches between the flanges and each pair is provided with a powerful brake.

The levers which control the brakes, link reversing and other motions, are conveniently arranged for working and for maintenance.

The following approximate prices for engines as above described refer to the powers and proportions in general use. Modifications must occasionally be made but they rarely affect the cost to any important extent.

The cost of locomotive boilers and accessories. For general information relating to boilers and fittings see pages 24 to 43 of Section I.

PRICE OF SIDE DRUM WINDING ENGINES, Fig. 2285.

Nominal horse power	16	20	30	40
Effective ,, ...	40	50	75	100
Prices of engines	£380	£450	£580	£700

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

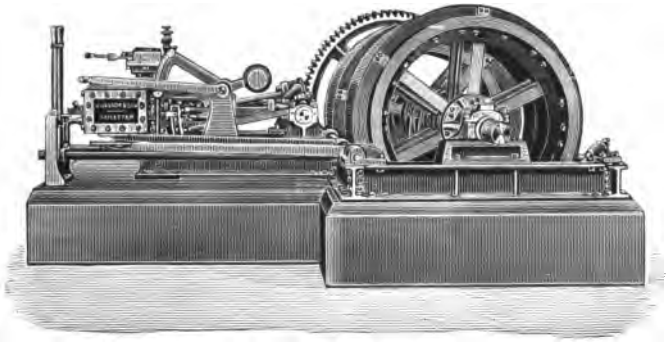


Fig. 2286

GEARED WINDING ENGINES.—The arrangement indicated in Fig. 2286 represents a smaller but very efficient pair of winding engines, cheaper in construction, having double loose drums, in wrought iron ; the cylinders, link reversing motion, spur gearing, brakes and clutches, are similar to the engines above described.

The prices of these winding engines are about 10 per cent. less than those given under Fig. 2284 : for instance an engine of 30 effective horse power costs .. .. £235.

HAULING ENGINES FOR INCLINE AND UNDERGROUND WORKINGS.—Fig. 2287 and 2288. Fig. 2287 is a double cylinder engine fixed on timber frame, and Fig. 2288 is a single-cylinder engine mounted on low trolley, plain or flanged wheels ; but either can be made portable or fixed. The frames of the engines are made throughout of wrought iron or mild steel ; and everything is done to keep down the weight and bulk, and to adapt them for the rough usage they so often meet with underground, working in dirt, and grit with very little attention, the attendant rarely being a mechanic. Each engine is fitted with link reversing gear, double drums, and separate brakes and clutches, so that the drums can be used quite independently of each other.

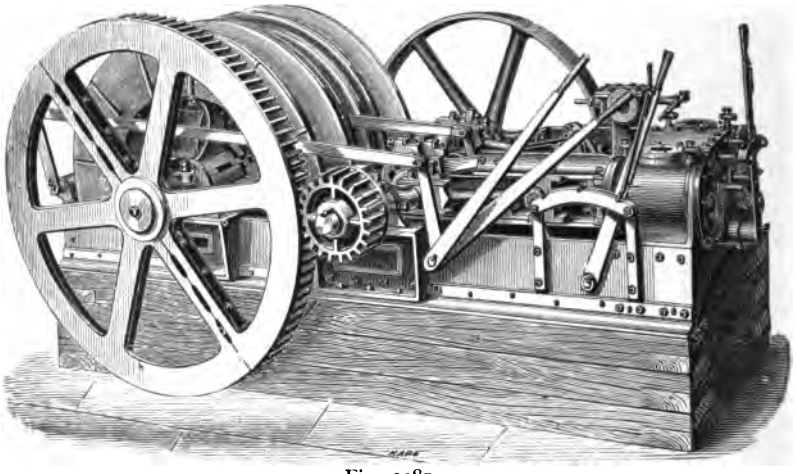


Fig. 2287.

These engines are frequently driven by compressed air, and are fitted with valves which effectually prevent the formation of ice in the exhaust ports. But (unless otherwise specified) they are constructed to work by steam at a pressure of 80 lbs. per square inch and the power developed is, of course, in proportion to the pressure available. The clutches are all of wrought iron case hardened, the drums are bushed with gun metal running loose on the shafts, and the brakes are turned on their faces.

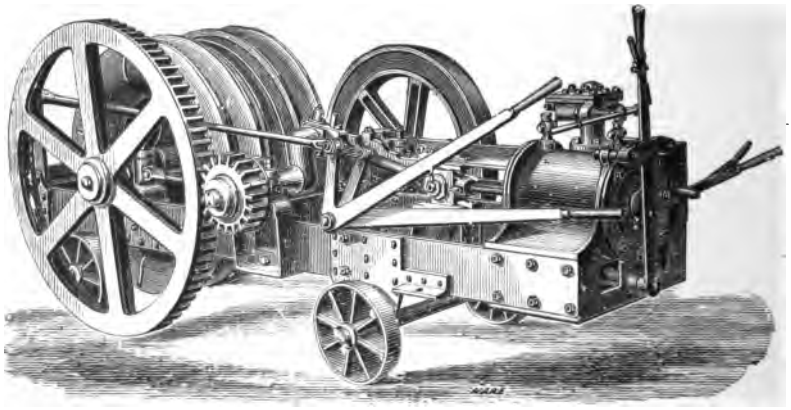


Fig. 2288

PRICES OF DOUBLE CYLINDER HAULING ENGINES, Fig. 2287.

Nominal horse power	10	14	16	25	35
Effective ,, (80 lbs. pressure) ..	25	35	40	65	85
Diameter of drums .. .. .. inches	36	42	42	48	48
Price of fixed engine	£235	£280	£315	£355	£415
,, portable engine	£250	£295	£335	£380	£440
Approximate weight .. .. tons	5½	6	7	10	11
,, extreme width .. feet	6	6	6½	7	7½
,, ,, height .. ,,	6	6	6½	7	7
,, ,, length .. ,,	14	14	15	16	16½

PRICES OF SINGLE CYLINDER HAULING ENGINES, Fig. 2288.

Nominal horse power	5	12	20
Effective ,, (80 lbs. pressure)	12	30	50
Diameter of drum .. .. inches	24	36	42
Price of fixed engine	£125	£170	£240
,, portable engine	£135	£182	£255
Approximate weight .. .. tons	2¼	3¾	5¼
,, extreme width .. .. .. feet	4	4½	5
,, ,, height .. .. ,,	4½	5	6
,, ,, length .. .. ,,	7	12	13

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

INDEPENDENT GEARED WINDING ENGINES AND BOILERS.—The arrangement indicated in Fig. 2289 is well known in South Africa, Australia, and other mining districts, where economy is sought in lightness of parts in conjunction with the strength and proportions to withstand heavy continuous work, rather than in the first cost of the machinery.

The engines and winding gear are carried in a steel frame and are fixed in any convenient position relatively with the boiler. The guide bars, shafts, gear, drums, &c., are of steel and the working parts are of exceptionally large proportions.

The boilers (unless otherwise stipulated) are of the locomotive type which—in construction and fittings—comply with the Board of Trade regulations relating to boilers to carry a working pressure of 80 lbs. per square inch. They are complete with chimney, feed water appliances and wrought iron or mild steel steam pipes to the engines.

The prices are approximate but are intended to cover the cost of all probable deviations from standard dimensions, weights of parts, &c.

Fuel.—It is assumed that good coal will be provided for the boilers; if this is not available, due allowance must be made for the extra heating surface required for working with fuel of inferior quality, or for burning wood.

PRICES OF INDEPENDENT WINDING ENGINES. Fig, 2289.

Nominal horse power	10	14	20	25	30	40	50
Effective ,, ...	25	35	50	65	75	100	125
Prices of engine, boiler, &c.	£425	£525	£630	£720	£830	£990	£1170
Approximate weight .. .. tons	10	12	17	20	22	32	42
,, measurement cub. feet	660	705	945	1090	1340	1815	2280

The cost of packing for shipment and delivery f.o.b. is 5 per cent

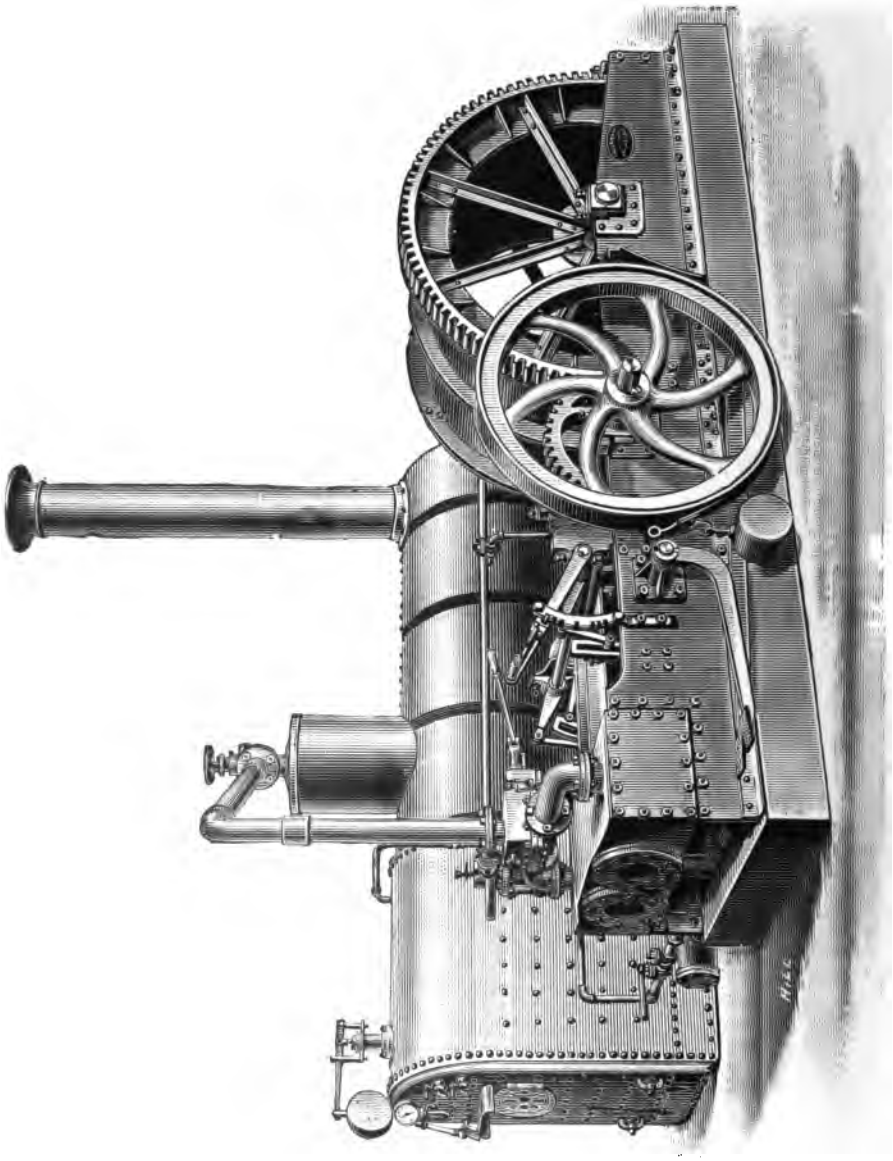


Fig. 2289

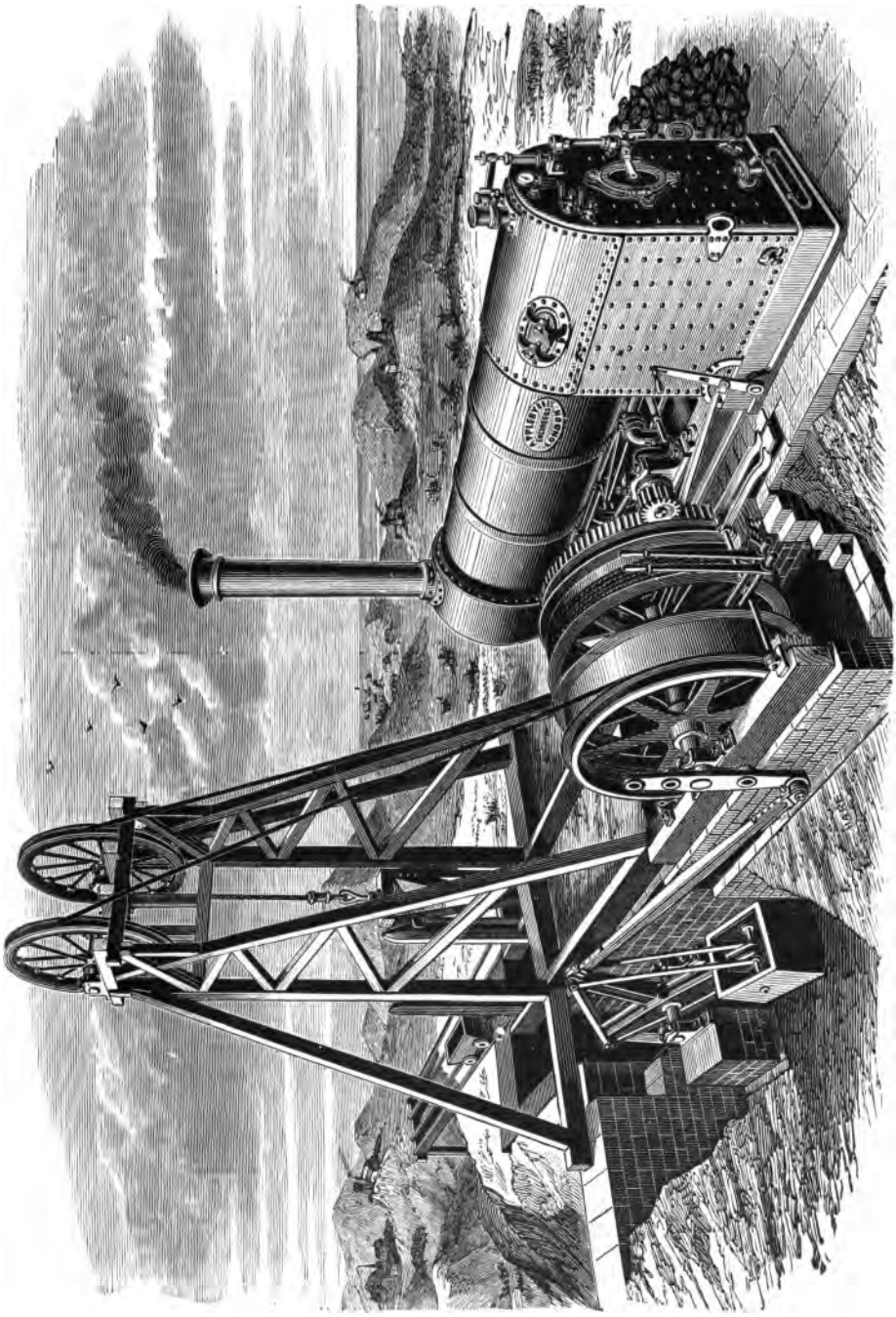


Fig. 2290

COMBINED WINDING ENGINES AND BOILERS.—The plant illustrated in Fig. 2290 was designed and constructed by the author's firm and has been in constant work for many years.

Foundations.—The engines may be erected on masonry and timber, as shown in Fig. 2290, but a large number have been built with the wrought iron girder underframes illustrated in Fig. 2291, and these will be supplied if desired.

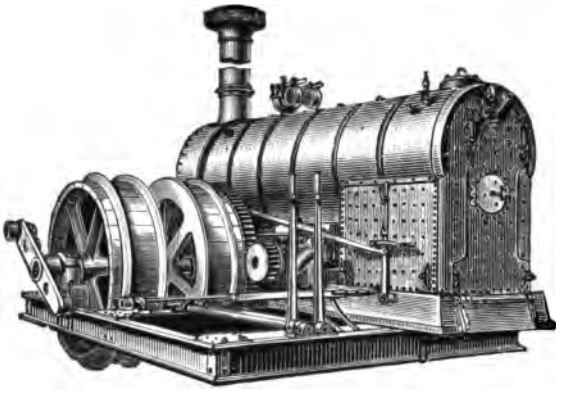


Fig. 2291.

Another useful form of foundation is a strong wrought iron tank which will contain an ample supply of feed water. The cost of this and of an injector as an auxiliary to the steam donkey pumps supplied with the machinery, will be found below.

The boilers, of the locomotive type, are constructed of mild steel; the longitudinal seams are double riveted and all rivets are closed by hydraulic machine. Each boiler is tested by hydraulic pressure to 220 lbs. per square inch and provided with the highest class of steam, feed water and furnace fittings. The enlarged fire box is required if the fuel is inferior to English coal.

Machinery.—Steel is largely used in the construction of this machinery and, if winding rom different depths is required, the drums are made of the diameters suitable for those different depths.

Engines required for winding only have the drums keyed on the shaft and this is contemplated in the estimates of cost. If the engine is required to drive other machinery occasionally, the pinion on the crank shaft is arranged to draw clear of the wheel on the drum spindle for power to be transmitted by a belt, off the fly wheel. But if the engine is to be used for pumping, as well as for winding, a separate pumping shaft must be provided, or the drums must be loose on the shaft and connected to it by steel clutches; the extra cost of these will be found in the list.

Lifting and hauling power see table at page 134.

THE PUMPING ARM is made of wrought iron or cast steel and keyed on the drum shaft; the crank pin is of steel and is turned to fit any of the holes which are provided in the arm for varying the stroke of the pump.

PRICES OF WINDING ENGINES, &c., Fig 2290.

Nominal horse power		12	14	16	20	25	30	50
Effective ,, ...		30	35	40	50	65	75	125
Diameter of drums	inches	48	48	48	54	60	60	72
Speed of rope per minute ..	feet	460	460	460	500	500	500	600
Price of engine with one drum ..		£405	£440	£475	£555	£640	£760	£1170
,, ,, two ,, ..		£445	£480	£515	£600	£710	£830	£1270
Loose drum and clutches ..	each	£11	£11	£12	£12	£14	£15	£25
Price of tank foundation		£50	£60	£65	£70	£80	£90	£140
Extra injector and fittings		£8	£8	£9	£10	£11	£12	£15
,, enlarged fire box		£8	£10	£12	£16	£20	£25	£30
,, for pumping arm		£9	£9	£10	£11	£12	£13	£18
,, independent pump gear ..		£80	£90	£100	£125	£140	£160	£209

The cost of packing for shipment and delivery f.o.b. varies according to destination, &c., but may be assumed to cost from 5 to 10 per cent.

ELECTRIC HOISTING AND HAULING MACHINERY.—The arrangements referred to at pages 134 to 148 are so easily modified to work by electric motor, that illustrations and descriptions need not be repeated.

The alterations consist mainly in substituting an electric motor with bed plate and suitable gear, for the engines and boiler shown in the engravings ; an example of this is given in Fig. 2232.

The conditions under which electrically driven machinery is advantageously employed for the above named purposes, are mentioned at page 3, and information relating to the transmission of power will be found at pages 68 and 69.

The cost of electric hoisting machinery does not vary widely from that of plant of equal power with engines and boiler.

BELT DRIVEN WINDING OR HAULING GEARS worked from an existing engine or other motor, are usually attached to masonry or timber foundations, but at an extra cost of 20 to 30 per cent. they can be sent out complete with a steel girder frame as indicated in Fig. 2291, ready for re-erection at destination.

The width of the two drums together is usually rather more than that of the single drum and disengaging clutch, strap, brake, and levers are provided for each drum. The drum shaft is of mild steel and is carried in pedestals with hard gun metal bearings as shown in Fig. 2290.

The subjoined approximate prices include the spur wheel on the drum shaft and pinion for driving it, the proportions of wheel and pinion being those usual for steam driven gear, which necessarily vary according to requirements.

PRICES OF BELT DRIVEN WINDING AND HAULING GEARS.

Effective horse power	20	25	40	60	75
Diameter of drum .. .. inches	42	48	54	60	66
Width ,, ... ,,	16	18	21	25	28
Price of single drum with clutch ..	£55	£70	£85	£105	£140
,, double ,, ,, ..	£90	£110	£135	£170	£215

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

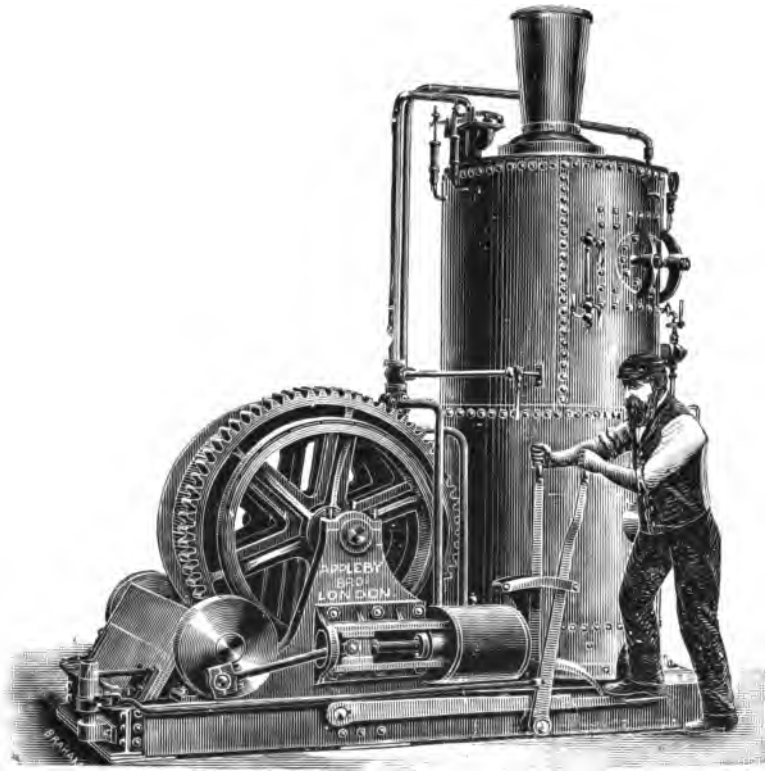


Fig. 2292

WINDING AND HAULING ENGINES, of the construction indicated in Fig. 2292, occupy a minimum space and are made complete with vertical boiler, as shown, or without boiler, to suit situations where a different source for steam supply is preferred.

The boiler and engines are mounted on a bed plate and carried on wrought iron girders, or on a tank, so that little or no expense is incurred in making foundations.

The prices will be found below for each of the combinations in which these engines are usually made ; if others are required they will be subjects for special design and estimate.

PRICES OF WINDING AND HAULING ENGINES, Fig. 2292.

Nominal horse power	6	10	16	25
Effective ,, ...	15	25	40	65
Diameter of drum or drums .. .. .. inches	29	36	42	48
Price with boiler and two drums	£264	£353	£440	£566
Approximate weight .. .. tons	5	6¾	9½	13
Price with boiler and one drum	£254	£334	£413	£555
Approximate weight .. .. tons	4¾	6½	8½	12
Price without boiler, two drums	£165	£215	£260	£346
Approximate weight .. .. tons	3	4	6¼	8¾
Price without boiler, one drum	£155	£196	£233	£335
Approximate weight .. .. tons	2¾	3¾	5¼	7¾
Price for steel gearing	£8	£17	£27	£33
,, wrought iron drums	£20	£28	£33	£40

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

HORIZONTAL CYLINDER PORTABLE HOISTING ENGINES.—The arrangemenet of the portable engine, Fig. 2293, is generally similar to that illustrated by Fig. 2292, excepting that it is mounted on plain wheels—as shown—or on flanged wheels to travel on rails.

Fig. 2293.

The engines and winding gear.—The steam cylinders are fixed horizontally on each of the side frames, and are fitted with link reversing motions. The winding barrel, spur wheel, and brake wheel are carried between the side frames and the main wheel is driven by a steel pinion on the crank shaft.

The levers controlling the reversing motion, the brake and the sliding pinion on the crank shaft are at one side and near to the fire door.

The boiler is of the cross tube type and built of mild steel to carry a working pressure of 80 lbs. per square inch. It is complete with chimney and is provided with all furnace, steam and feed water fittings and connections.

The undercarriage is of wrought iron and forms a feed water tank. The axles are of wrought iron and the travelling wheels are plain or flanged, as desired.

PRICES OF PORTABLE HOISTING ENGINES, Fig. 2293.

Nominal horse power	6	8	10
Effective ,, ...	15	20	25
Price of hoist	£175	£200	£230
Approximate weight .. .. tons	3¼	4	5

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

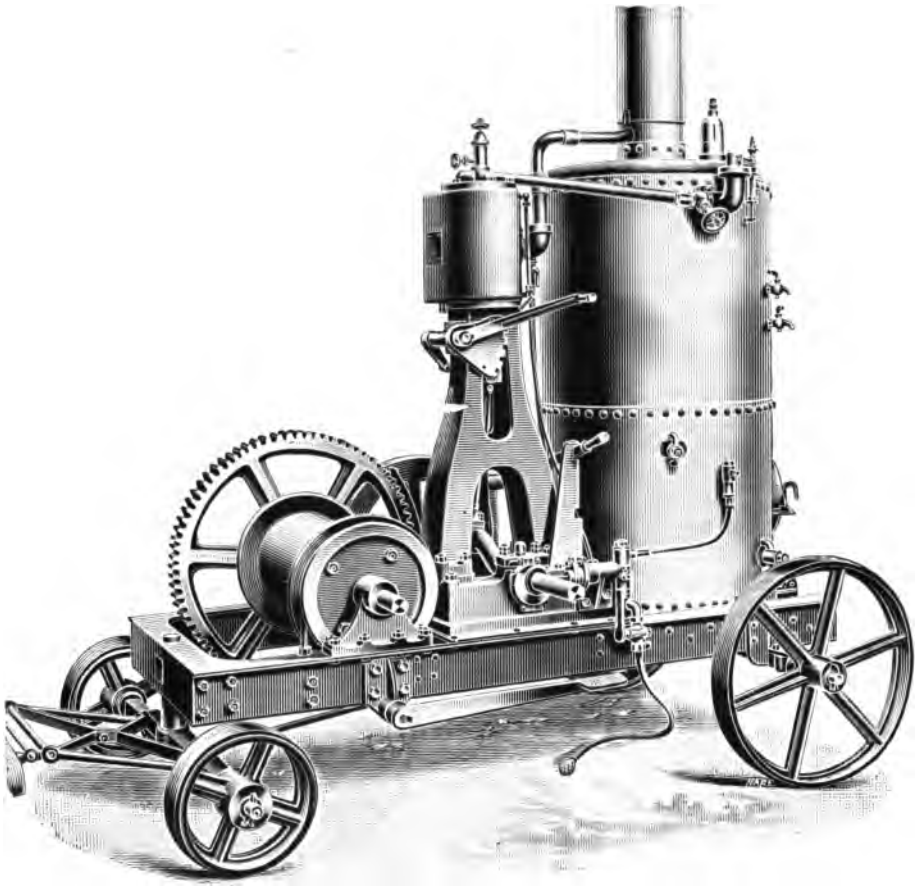


Fig. 2294

VERTICAL SINGLE CYLINDER PORTABLE HOISTING ENGINE,

Fig. 2294.—The boiler, engine and machinery are fixed on a wrought iron undercarriage with road wheels and swivelling fore carriage as illustrated, or with plain or flanged trolley wheels. The boiler has cross tubes and is provided with all fittings and accessories.

Wire rope drum.—The barrel shown in the engraving is intended to coil short link crane chain, but the engine can be adapted for winding at high speed, with flexible wire rope when desired, by fixing a shell drum outside the chain barrel. The attachments are provided for fixing the drum in a few minutes and the engine is thus made available for working with chain or rope but as the rope works at a higher speed the load must be proportionately reduced. The cost of this accessory will be found below.

A warping drum can be fixed on the end of the barrel shaft; the cost of this will be found below.

PRICES OF PORTABLE HOISTING ENGINES, Fig. 2294.

Nominal horse power	2	3	4	5	6	8
Effective ,, ...	5	7	10	12	15	20
Price with road wheels and fore carriage ...	£96	£107	£140	£170	£200	£230
,, trolley or flanged wheel	£90	£100	£132	£160	£190	£215
,, of wire rope (outer shell) drum	£2	£3	£3	£4	£4	£5
,, warping drum	£2	£3	£3	£4	£4	£4
,, lagging boiler	£5	£6	£7	£8	£9	£11
Approximate weight ... ... tons	1¾	2¼	2¾	4	5¼	7

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

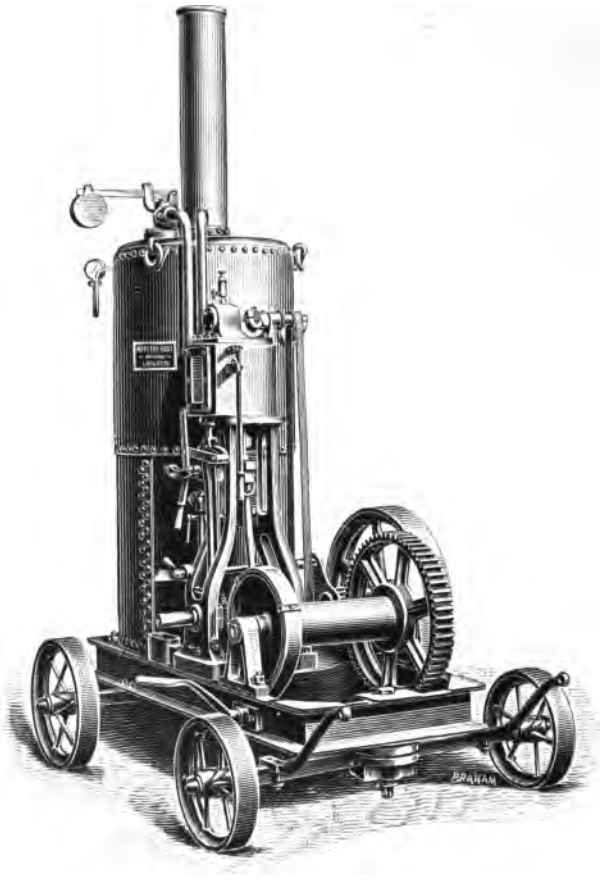


Fig. 2295.

SINGLE CYLINDER PORTABLE HOISTING ENGINES, Fig. 2295, represents an improved type of the well known "Steam Barrow Hoists," so called from the fact that they were originally built for raising and lowering barrows for excavation in trenches, and other foundations, raising materials for buildings in construction, &c.

Many engines of this type of 3 nominal h.p. were employed in making the excavations for the foundations of the Thames Embankment, where the space was too limited for the (then) usual "horse run."

Two chains coil on the barrel in opposite directions and 35 to 40 double operations (upcast and downcast) per hour are easily made with a lift of about 35 feet. The engines referred to were driven by boys, and the cost of working, including fuel, oil and driver's wages, was only about four shillings and sixpence per day.

The undercarriage is of wrought iron, with a feed water tank under the boiler, and is usually mounted on four plain or flanged wheels, as shown in Fig. 2295. But the wheels are arranged to admit of the engine being traversed at a right angle with its length. In other cases it is provided with road wheels and swivelling fore carriage, as illustrated.

The engine, Fig 2295 was built for occasional use in hoisting, but principally for driving a dynamo. For this purpose it was necessary to have sensitive governors which could be easily thrown off when the engine was used for hoisting ; it works quite satisfactorily under both these conditions.

Many other modifications have been made, such as arranging the engines to whip coal over a block suspended from a boom on the import vessel and haul a number of turnover trucks to the gas works, a distance of about 500 yards. Although this duty is exceptional, three of the engines are employed at the gas works referred to.

The prices include all levers and other usual accessories, but not the governors which are not required for hoisting engines.

PRICES OF PORTABLE HOISTING ENGINES, Fig. 2295.

Nominal horse power	2	3	4	6
Price with road wheels, &c.	£124	£135	£160	£204
,, plain or flanged wheels	£120	£128	£150	£192
,, of governors and accessories	£4	£4	£5	£6

INCLINE GEARS FOR STEEL WIRE ROPE FOR DOUBLE LINES usually consist of a clip drum, or a strong cast iron pulley with V groove and a powerful brake, these being mounted on a wrought iron or timber frame with a cast iron centre to carry the steel spindle which revolves in hard gun metal bushes. See page 54 Section VI. Part A.

For a single road the pulley has a flat rim with deep flanges, and is carried in a frame as above described.

LIFTS OR "ELEVATORS."—The engravings, Fig. 2296 to 2301, indicate a few of the conditions fulfilled by these invaluable appliances, but the dimensions, modes of driving, internal fittings, &c., vary so widely, that the cost of some of the types referred to cannot be estimated until these details have been defined.

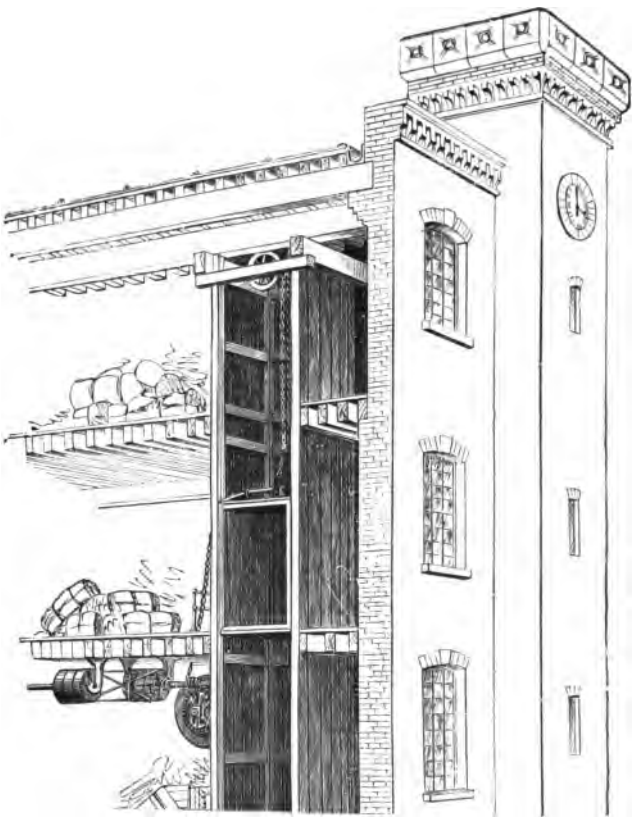


Fig. 2296

BELT DRIVEN SELF SUSTAINING LIFTS employed as shown in Fig. 2296 are usually suspended from flexible steel wire ropes coiling on a spirally grooved drum. The gearing (driven from a line of shaft, a steam, gas, or other motor) may be fixed as shown, or in any position which may be more convenient.

The self-sustaining gear comes into operation automatically and holds the load stationary if the driving power should be accidentally removed. In addition to this, automatic stopping gear is provided which is regulated to come into action at any point desired.

Safety apparatus.—Amongst the numerous devices to ensure safety, perhaps none is so simple and efficient as the plate spring (similar to a carriage spring) which is in compression so long as the rope is intact, but instantly brings a pair of steel pawls into operation and holds the cage suspended in the event of breakage of the lifting chain or rope. The cost of this apparatus will be found below.

The cages or platforms of goods or luggage lifts are built of timber with the necessary ironwork for frames, ties, antifriction guide rollers, bolts, &c.

The rising room of passenger lifts is built of pitch pine neatly stained and varnished and fitted with sliding doors and fittings, ready for such decoration as may be desired.

The prices include the lifting gear, rope, and cage, as described, the counterweight frame and rope, hand rope, guide pulleys, and brackets and all usual accessories, but not countershaft and pulleys, driving belts, or timber guides.

PRICES OF BELT DRIVEN GOODS OR LUGGAGE LIFTS, Fig. 2296.

Power of lift .. .. cwts.	5	10	15	20	30	40
Height traversed .. .. .. feet	25	25	25	25	30	30
Area of cage .. .. .. square feet	9	10½	16	18	22½	30
Height ,, ... feet	6	6	6	6½	6½	7
Price of gear and cage	£60	£75	£85	£95	£115	£145
Extra height .. .. .. per foot	3/-	4/-	5/-	6/-	6/-	6/6
Safety apparatus..	£6	£8	£11	£13	£15	£19

PRICES OF BELT DRIVEN PASSENGER LIFTS, Fig. 2296.

Passengers seated	4	6	8	10
Height traversed .. .. feet	40	40	40	40
Area of cage .. .. square feet	18	30	42	49
Height ,, ... feet	7	7½	8	8
Price of gear and cage	£110	£120	£130	£140
Extra height .. .. per foot	7/-	7/-	8/-	8/-
Safety apparatus	£6	£8	£11	£13

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

SELF CLOSING AND LOCKING DOORS.—A simple and efficient invention for the prevention of accidents consists of a balanced sliding door which can be opened only when the cage has been stopped opposite to it, but which is automatically closed and locked so soon as the cage commences to move.

The price of the doors varies in proportion with the size, the attachments required, &c., but usually ranges from £7 to £10 per set.

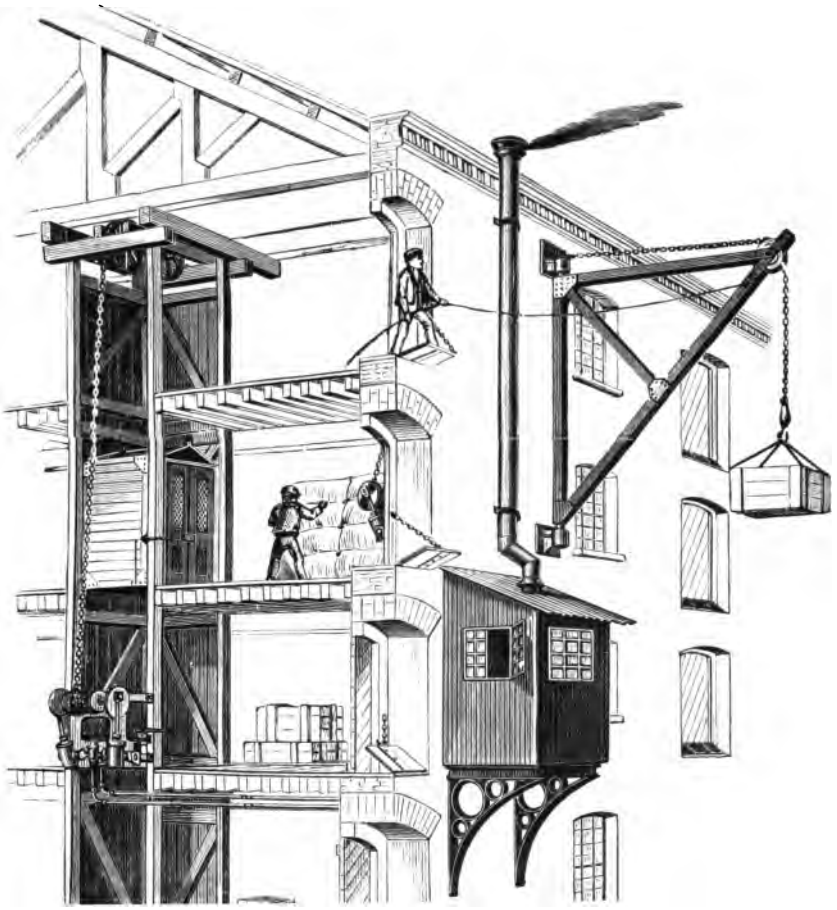


Fig. 2297.

STEAM DRIVEN LIFT AND WAREHOUSE CRANE.—The lift and crane, Fig. 2297, are provided with winches similar to Fig. 2306 and supplied with steam from a boiler in the corrugated iron house shown in the engraving This arrangement was adopted to minimise the risk of fire and avoid increase in the rate of insurance on the building and its contents

Machinery.—The chain connecting the winch with the cage is carried over a grooved pulley at the top of the timber frame. The cage is of wrought iron lined with wood; the area of floor is about 16 feet and it carries a net load of 15 cwt. A counterweight, with chain and guide sheaves, balances the net weight of the cage; the lifting and lowering motions are controlled from any of the floors by a rope attached to the stopping and starting lever on the winch

The speed of lift usually averages about 100 feet per minute, but this is modified by the attendant to any extent desired.

The wall crane is built of steel and is slewed (as usual) by hand power, but steam slewing motion can be added, if necessary. The working load is 15 cwt.

SUSPENDED HYDRAULIC LIFTS.—When the cost of putting down a bore hole for the cylinder (or other reason) precludes the use of the direct acting system (Fig. 2298), the cage is suspended and the chain or steel wire rope coiled over a cylinder and ram fixed horizontally as shown in Fig. 2201, or vertically as in Fig. 2203. The controlling valves are worked as above described.

DIRECT ACTING HYDRAULIC LIFTS Fig. 2298 represents a passenger lift with the head of the ram secured to the floor of the rising cage, the length and area of the cylinder and ram being adequate for the height of lift and the pressure available.

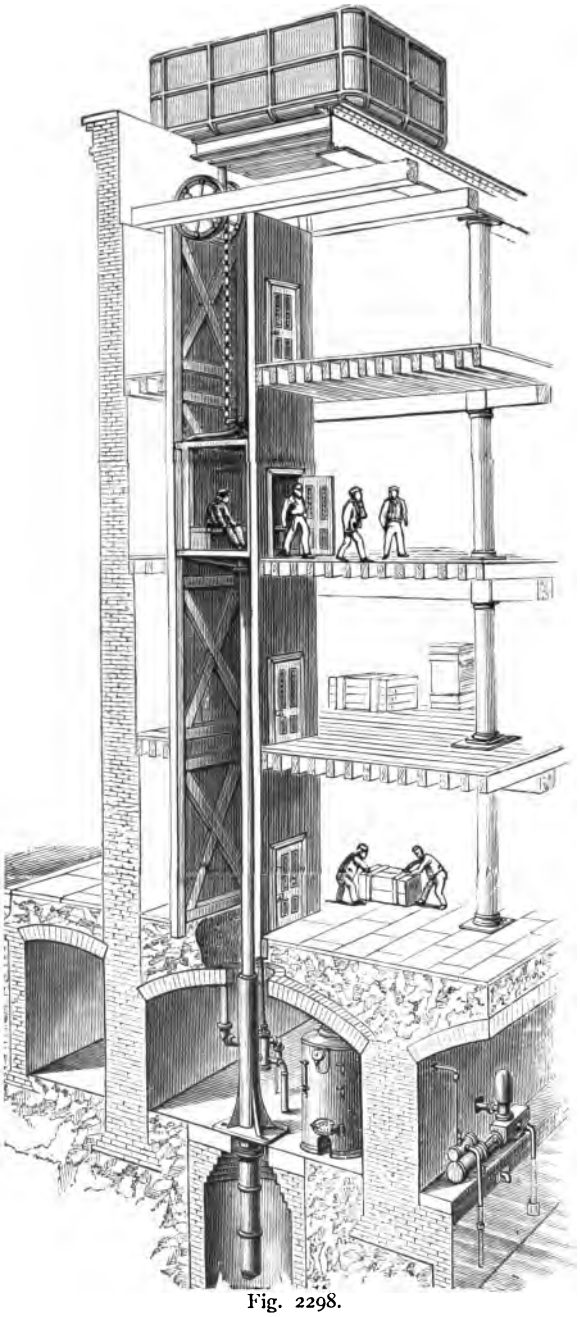


Fig. 2298.

The ram works through a leather packing at the top of the cylinder and the lifting, stopping and lowering motions are controlled by a rope passing through the cage or outside it, as convenient.

The hydraulic pressure for the lift referred to was obtained by gravitation from the large tank at the top of the building. A pump in the basement maintains the supply by raising the water which has been exhausted from the cylinder. Lifts are sometimes worked by water taken direct from the ordinary water mains, but these relatively low pressure (and frequently uncertain) supplies are undesirable, unless—as in the building referred to—the water in the tank is regarded as a first aid in case of fire.

The usual pressure of 700 lbs. per square inch is much more economical and, in every sense, preferable.

The rising room (Fig. 2298) seating 12 persons, is neatly upholstered and provided with a lamp in the roof.

The cost of the lift including the hydraulic cylinder and ram with a stroke of about 40 feet, the rising room and the exceptional items of large upper and lower tanks, pipes, pumping engine, boiler, &c., is about £950.

LIFTS FOR HOTELS AND PUBLIC BUILDINGS vary so widely in dimensions and equipment that they must always be specially designed.

If a sufficiently high pressure cannot be obtained from public supply mains, it is almost invariably more satisfactory to generate the power by pumps driven by steam, gas or oil engine, or by an electric motor, than to be dependent on low and (probably) uncertain pressures.

LIFTS WORKED BY ELECTRIC MOTOR.—A comparatively small addition to the plant required solely for electric lighting, provides power for working the lifts. The increase in working expenses is scarcely worth consideration, the generators being usefully employed during the day when otherwise they would probably be idle.

The electric winch is fixed where may be most convenient—frequently at the base of the lift. Complete safety is attained by driving with worm and wheel gear, duplicate ropes, and automatic stopping gear.

HAND POWER SELF SUSTAINING LIFTS vary widely as regards the arrangement of gear, but that illustrated by Fig. 2299, which can be worked from any floor, may be regarded as typical of the hand power lifts in general use.

The lifting and self sustaining gear is carried on brackets attached to the wall, or it is fixed on the top of the framing as shown in the engraving. This is the safest and best arrangement and is contemplated in the subjoined approximate prices. The load is raised or lowered by hauling on the endless rope passing over the V grooved pulley which controls the lifting and lowering motions, as indicated.

The cage (with or without safety apparatus) is as described at Fig. 2298 and is counterweighted, so that the power exerted is limited to that required to raise the net load in a single cage lift, or the difference between the net weight, respectively, in the ascending and descending cages of a double cage lift.

The prices include the lifting and self-sustaining gear, the counterweight, V grooved pulley with shaft and bearings, lifting chain, and hauling rope, but no timber guides or antifriction rollers.

PRICES OF HAND POWER SINGLE CAGE LIFTS, Fig. 2299.

Power of lift .. .. cwts.	5	8	10	12
Height of traverse .. .. feet	30	30	30	30
Area of cage .. .. square feet	15	24	30	40
Height ,, ... feet	6	7	7	7
Price of lift	£45	£60	£65	£70
Extra height .. .. per foot	4/-	5/6	6/-	7/-
Safety apparatus	£6	£7	£8	£9
Anti-friction rollers	£2	£3	£3	£3

PRICES OF HAND POWER DOUBLE CAGE LIFTS, Fig. 2299.

Power of lift .. .. cwt.	5	6	8	10
Height of traverse .. .. feet	30	30	30	30
Area of each cage .. .. .. square feet	5	6½	7½	9
Height ,, ... feet	6	6	6	6
Price of lift	£40	£45	£50	£60
Extra height .. .. per foot	3/6	4/-	4/6	5/-
Safety apparatus	£6	£7	£8	£9
Anti-friction rollers	£2	£3	£3	£3

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

VERTICAL BASEMENT LIFT.—Fig. 2300 indicates the conditions fulfilled rather than the details of construction, these being arranged to suit the positions of winch and cage, the level at which goods are to be delivered, above or below, &c.

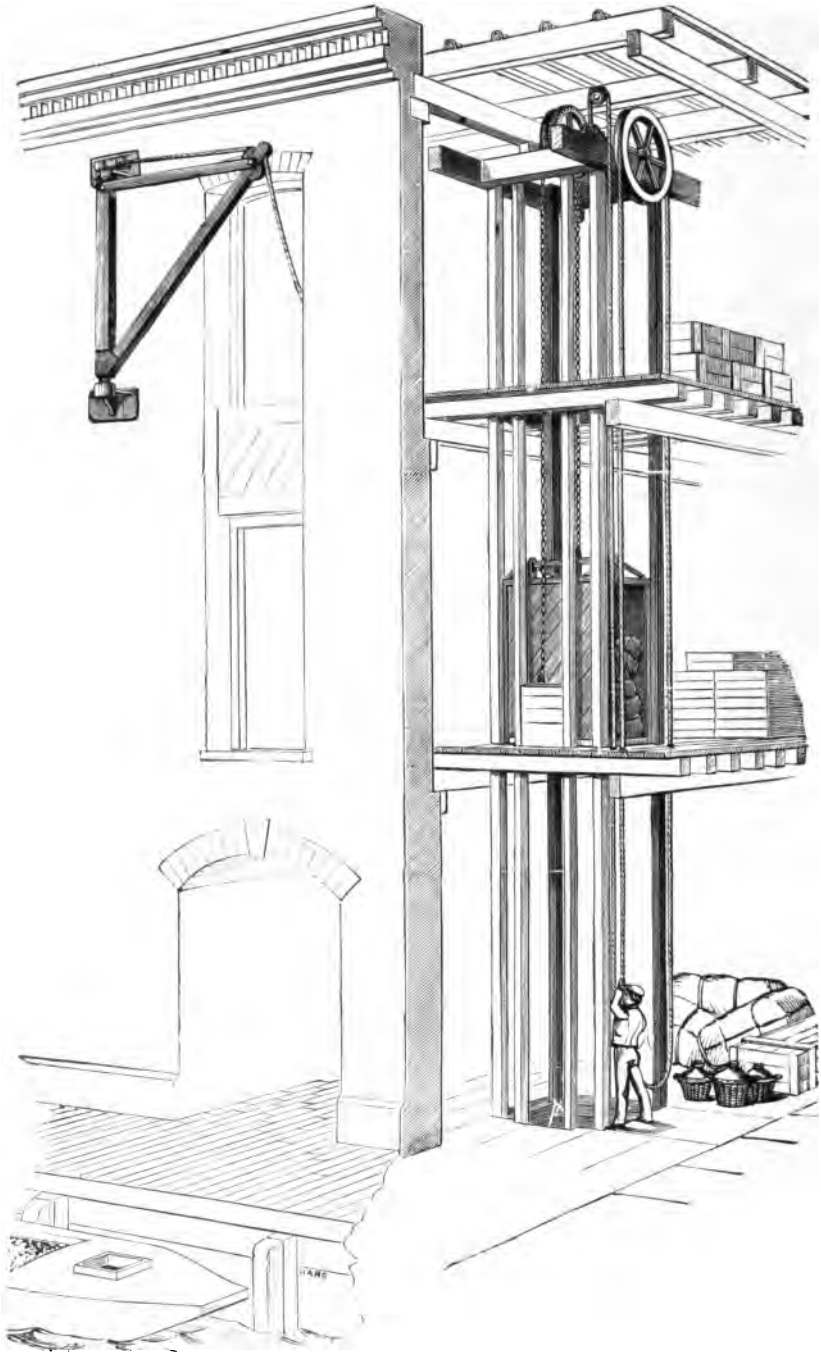


Fig. 2299

The prices include the platform with iron frame fitted with antifriction rollers, hand power winch to fix to the wall or floor, short link tested crane chain and attachments, chain pulley and accessories, but not the top and bottom frames and vertical guides, which are inexpensive and frequently made locally.

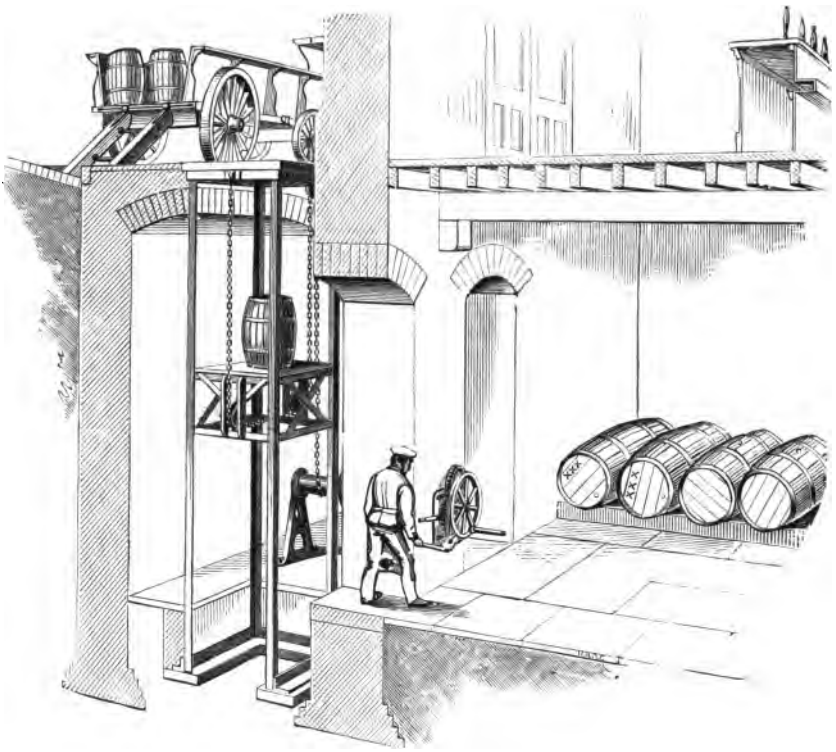


Fig. 2300.

PRICES OF HAND POWER BASEMENT LIFTS, Fig. 2300.

Power of lift ... ... tons	¼	½	¾	1
Height traversed ... ... feet	10	10	10	10
Area of platform ... ... square feet	10½	14	18	20
Price of lift	£30	£35	£40	£45
Extra height ... ... per foot	3/6	4 6	6/-	7/6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

THE INCLINED HAND POWER LIFT, Fig. 2301 is adapted for use where steps cannot be dispensed with, and the space occupied by a vertical lift is not at disposal for transferring casks or goods between road or ground floor, and basement levels.

Fig. 2301.

The winch with self-sustaining gear is fixed as shown, or (by preference) to the underside of the beams carrying the stairs.

The rising platform and stair are made of iron or timber and fitted with anti-friction rollers, best tested chain, chain pulleys, &c., as shown.

PRICES OF INCLINED HAND POWER LIFTS, Fig. 2301.

Power of lift ... ... tons	¼	½	¾	1
Height traversed .. .. feet	10	10	10	10
Area of platform ... . square feet	5	7½	10½	12
Price of lift, in iron	£35	£40	£45	£50
,, in timber	£30	£35	£40	£45

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

POWER BASEMENT LIFTS of the types Fig. 2300 and 2301 are also made to work by **hydraulic**, **steam**, or **electric** power.

BELT DRIVEN HOISTS sometimes need to be modified in details, but the general arrangements illustrated in one or other of the engravings Figs. 2302 to 2305 will probably be suitable for most purposes.

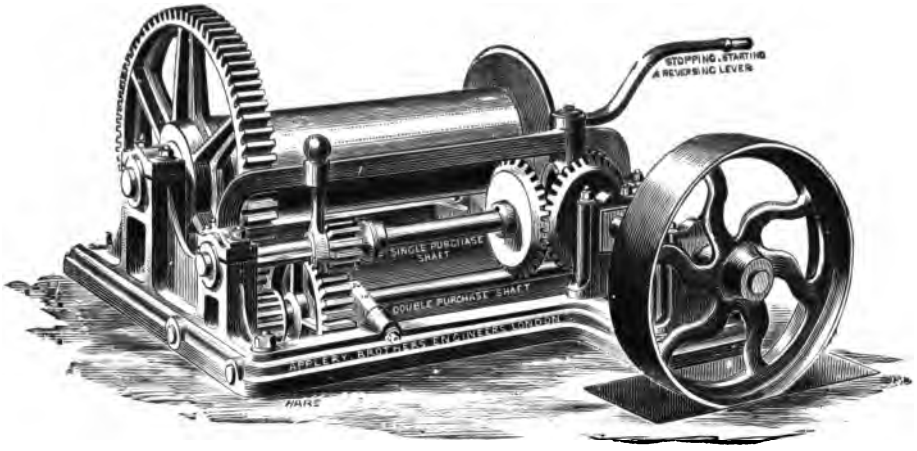


Fig. 2302

BELT DRIVEN FRICTION CONE HOISTS Fig. 2302 The single and double purchase lifting gear is carried on a strong cast iron frame with base plate to be attached to floor, wall or beams. The belt pulley may run continuously, the lifting and lowering motions being controlled by double cone friction clutches on the first motion shaft. The brake lever (not seen in the engraving) is below the stopping and starting lever. The bearings for the shafts are of hard gun-metal and of large proportions.

The price of the hoist Fig. 2302 to lift 15 cwt. in single purchase is about ... £60.

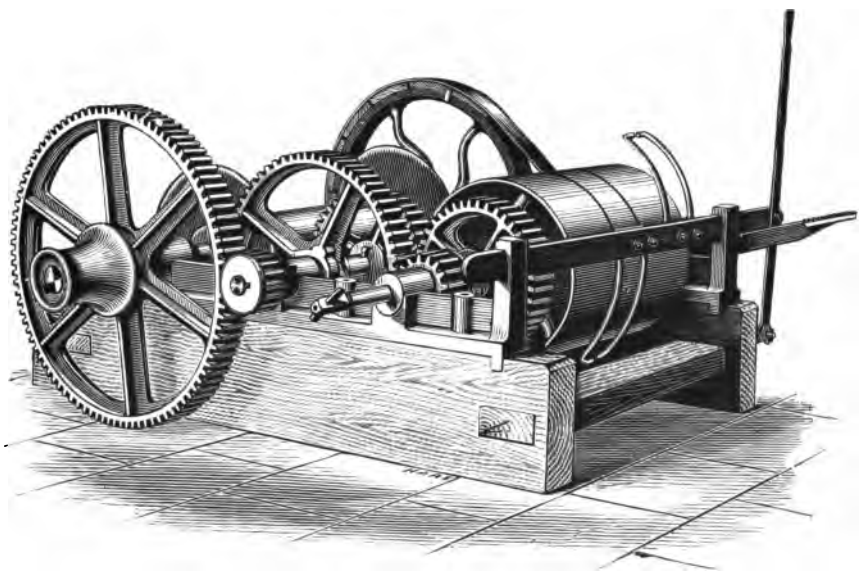


Fig. 2303

BELT DRIVEN HOIST WITH BELT REVERSING MOTION, Fig. 2303.—The hoist illustrated has been used for lifts, for hoisting materials with single chain and for setting columns, girders, &c., with blocks and falls, and for many other purposes. A pair of cast iron plates with bearings for the shafts are bolted to a timber or wrought iron frame ; the single and double purchase gear is provided with strap brake, and lever, and the lifting and lowering motions are worked by cross and straight strap, or by hand power.

The price of the hoist, Fig. 2303, to lift 15 cwt. in single purchase is about .. £40.

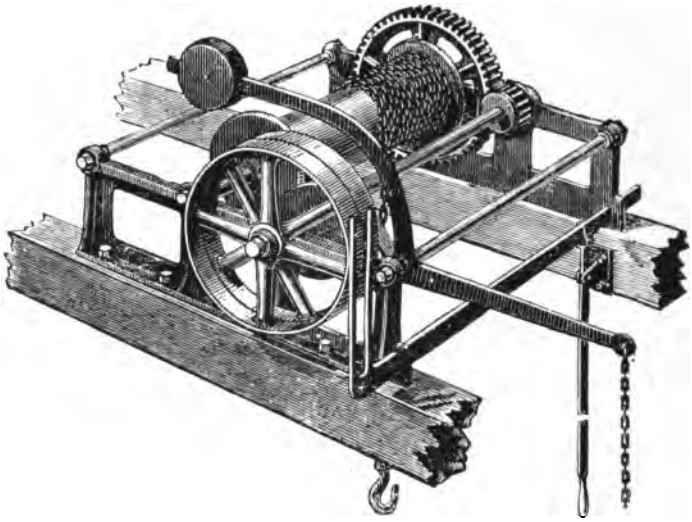


Fig. 2304.

BELT DRIVEN GEARED HOISTS.—The arrangement shown in Fig. 2304 is used in connection with lift cages, for hoisting goods in warehouses, workshops, mills, &c., and it is easily altered to fix in the position shown in Fig. 2305.

The side frames, ready for attachment to wood or iron beams, carry the single purchase spur gear, the counterweighted brake lever and the belt shifting apparatus.

Belt driven geared sack hoists.—The appliances illustrated may be used for this purpose, but for double chain sack hoists —one lifting whilst the other is lowering—the chain barrel is made with a central flange and the chain coils from opposite sides of the barrel.

The prices of the hoists include driving pulleys, striking and brake gear and levers, ready to fix to beams or masonry, but not the lifting chain and hook.

PRICES OF BELT DRIVEN GEARED HOISTS, Fig. 2304.

Power of lift ... ... cwt.	10	20
Price of ,, ...	£12	£15
,, gun-metal bushes for bearings	16/-	18/-
,, best tested chain ... ... per foot	-/8	-/10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

Belt driven friction hoist to fix to floor.—The machinery is similar to that last described but is fixed on an iron rectangular frame with bolt holes in the feet. The price of the machine with belt or rope pulley is given on page 159.

BELT DRIVEN FRICTION PULLEY HOISTS of the type Fig. 2305 are fixed to an overhead frame or to a floor, as mentioned below.

Power is transmitted by rope, as illustrated, or by belt as in Fig. 2304, and the lifting power is obtained by contact of the (driven) plain surface pinion with the wheel on the chain barrel shaft. The brake acts automatically the moment the line attached to the end of the lever is released from tension.

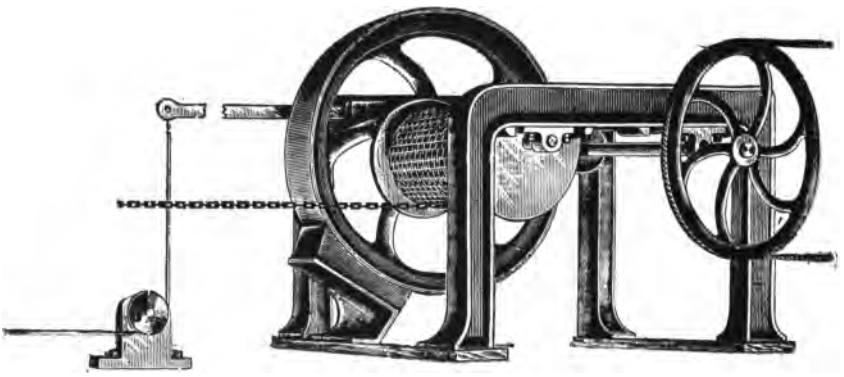


Fig. 2305.

Friction gear double sack hoist.—Another modification of this system specially adapts it for lifting and lowering sacks and bales. Alterations in the attachments, arrangement of driving gear &c. must sometimes be made, but the subjoined prices will be approximately correct.

The prices on the following page include the machine, with rope or strap pulley, ready for fixing but not the lifting chain or driving belt or rope.

PRICES OF BELT DRIVEN FRICTION PULLEY HOISTS.

Power of hoist ... ... cwt.	5	10	20
Price ,, Fig. 2305	£12	£16	£25
,, ,, to fix to floor	£16	£22	£34
,, double sack hoist	£20	£25	...
,, gun metal bushes for bearings	16/-	18/-	21/-
,, best tested crane chain ... per foot	-/7	-/8	-/10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

DIRECT ACTING STEAM WINCHES of the types illustrated by Fig. 2306 and 2307 work at any speed desired and almost noiselessly; they are usually fixed to a wall, but they work equally well fixed in any other position.

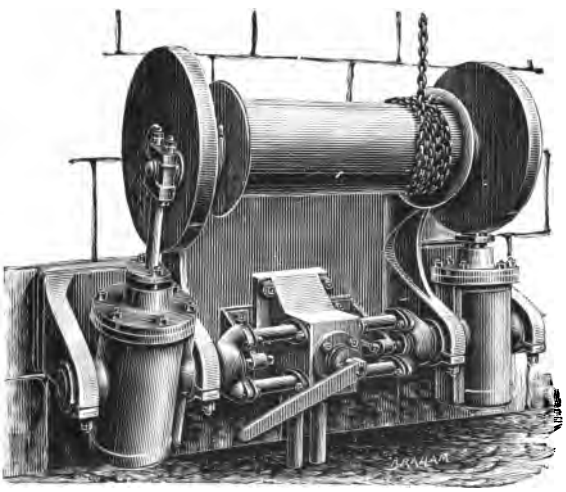


Fig. 2306.

As will be seen from the engraving the chain barrel is fixed on the crank shaft so that —if the barrel is eight inches diameter and makes only 100 revolutions per minute—the speed of lifting is 200 feet per minute. In practice this speed is much exceeded, but it is perfectly controlled by the stopping and starting lever which is worked by a line extending from the winch to the uppermost floor to be served, or by a lever direct.

The steam supply, usually at a pressure of 50 to 80 lbs. per square inch, is obtained from a boiler in any convenient position; that shown in Fig. 2297 is frequently adopted in warehouses where steam power is required only for cranes or lifts.

Although steam cannot be carried in pipes without some diminution in useful effect, the loss through a distance of 200 or 300 feet is so small—compared with the results obtained—that it may be left out of consideration.

DIRECT ACTING STEAM WINCH WITH OSCILLATING CYLINDERS, Fig. 2306.—A cast iron frame carries the steam cylinders with trunions of large surface and steam regulating and reversing valve between them. The latter are controlled by the lever and the chain barrel is keyed on the crank shaft as described on preceding page.

PRICES OF OSCILLATING CYLINDER WINCHES, Fig. 2306.

Lifting power ... ... tons	½	¾	¾	1	1¼
Diameter of cylinder ... ... inches	6	7	8	9	10
,, chain barrel ... ... ,,	6	7	8	9	10
Price of winch	£65	£75	£80	£90	£110

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

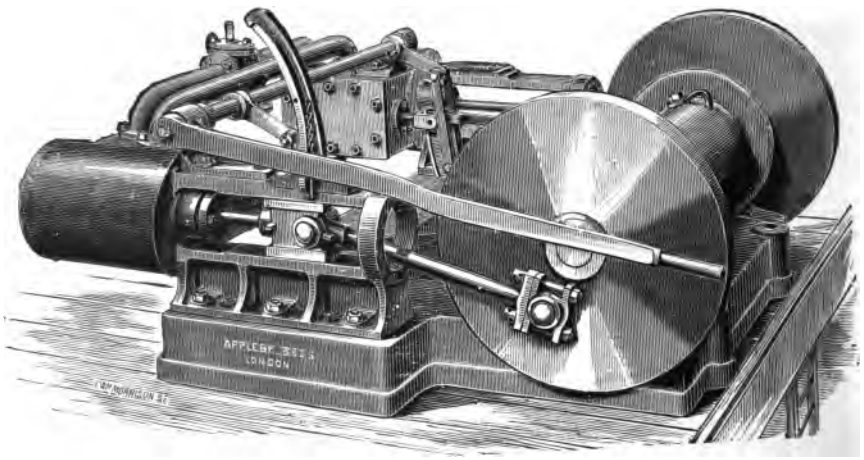


Fig. 2307.

DIRECT ACTING WINCH WITH HORIZONTAL CYLINDERS.—Winches of the type Fig. 2307 were originally designed for a line of steamers which usually take in and discharge cargo during the night, and must work as noiselessly as possible

The steam cylinders are fixed to a base plate and provided with case hardened link reversing motions which are used for lifting, stopping and lowering.

The chain barrel is keyed on the crank shaft and the motions are worked by the hand lever as shown in the engraving. The engines, discs, &c., are carefully balanced and the winches are always built to fulfil clearly defined conditions.

STEAM WINCHES—Space does not admit of illustrating many winches made for special purposes, but Fig. 2308 and 2309 are sufficiently typical of those in general demand.

DIAGONAL DOUBLE CYLINDER STEAM WINCH, Fig. 2308.—The side frames, which carry the engines and double purchase gear and capstan ends, are fixed to a strong bed plate with holes for bolts to the deck or foundation.

The steam stop valve and the levers which control the link reversing motions, the brake and the lifting pinion, are side by side. The steam cylinders are fitted with drain cocks and lubricators, steam and exhaust pipes, &c. The lifting gear can be worked by hand power if occasion requires.

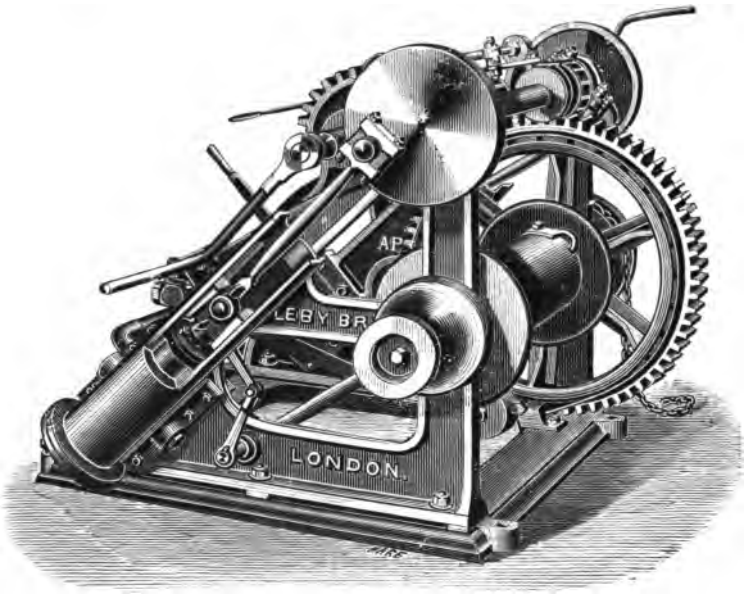


Fig. 2308.

HORIZONTAL DOUBLE CYLINDER STEAM WINCH, Fig 2309.—The engines, gear and fittings are as above described, but arranged horizontally ; the ends of the single and double purchase shafts are provided, respectively, with whipping and warping drums. These winches are not made to work by hand.

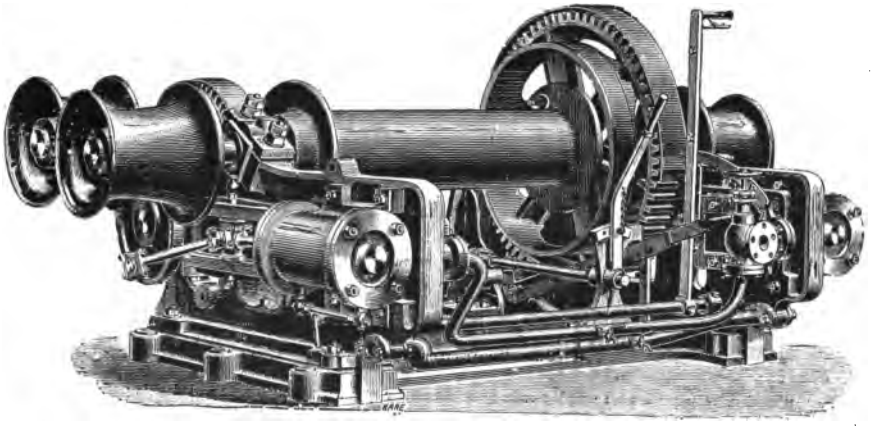


Fig. 2309.

PRICES OF STEAM WINCHES, Figs. 2308 and 2309.

Power of winch direct from barrel tons	1	2	3	4	5
Price of winch	£55	£63	£70	£80	£90

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PILE DRIVERS.—The following illustrations and descriptions relate only to winch-driving; other types of pile drivers—including those worked by electric motor, direct-acting steam, &c —will be referred to in Section V.

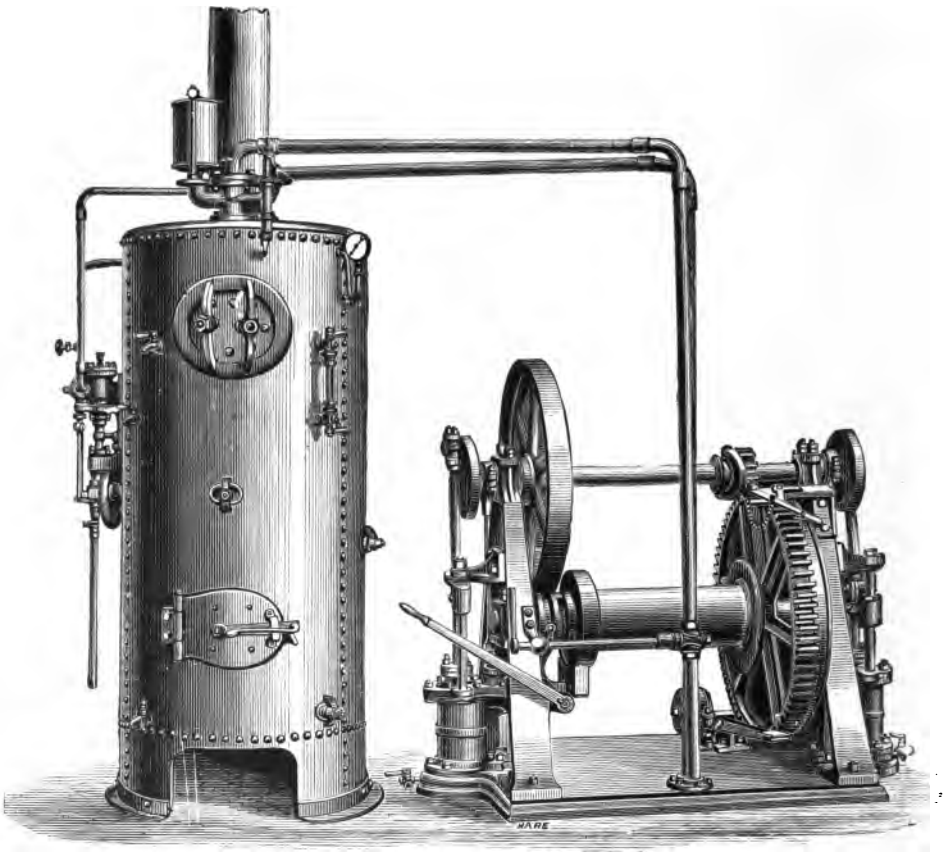


Fig. 2310.

STEAM PILE DRIVER WINCHES.—Almost any well constructed steam winch may be used for pile driving, but if a large number of piles are to be driven and speed is essential, the winch should be of the type Fig. 2310, which is specially adapted for rapid working and is available for all ordinary purposes.

The winch has single purchase gear and single or double cylinders (preferably the latter). Link motion is not necessary if the winch is to be used solely for pile driving, but it is almost indispensable for pitching piles and for many other purposes. The brake at the end of the chain barrel is used for checking the run out of chain when pile driving, the barrel being loose on the shaft, and made fast when desired by a double horned clutch; the same lever actuates both brake and clutch. A brake is also provided on the main spur wheel (controlled by a foot lever) for ordinary work.

The vertical boiler with cross tubes is built of steel; the longitudinal seams are double rivetted, and it is tested by hydraulic pressure to 150 lbs. per square inch. The chimney is usually about 4 feet high, and all usual fittings are provided.

Fig. 2311

PRICE OF STEAM PILE DRIVER WINCH AND BOILER, Fig. 2310.

Power of double cylinder winch .. .. .. tons	1½	2
Price of ,, ,, ,, ...	£85	£90
,, link reversing motions	£10	£10
,, boiler with fittings	£50	£60
,, donkey feed pump	£10	£11
,, injector and fittings	£7	£8

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

The price of a similar winch with one steam cylinder 6½ inches diameter is.. £65.
If with link reversing motions .. .. £71.

STEAM WINCH PILE DRIVING MACHINE, Fig. 2311, represents the frame as usually constructed. The height is 35 feet and the machine is adapted for driving a pile about 30 feet long. The angle of the frame can be adjusted to give the "batter" desired.

The pile engine and platform, to which the winch and boiler are fixed, are of pitch pine strongly framed and tied with bolts and ironwork. For use on land, the platform is mounted on plain or flanged wheels, which are easily adjusted to follow sinuosities in the grouping of piles. The leaders are faced with iron on their inner edges and supported by side struts; the back ties form a ladder to the top platform which carries the chain sheave, bearings, &c., and are firmly braced to the leaders as shown.

The nippers for seizing the "monkey" or ram are adapted for rapid working, and provided with trip gear adjustable to any desired length of stroke.

The prices include the double cylinder steam winch and boiler with feed apparatus, fittings and connections, the timber frame-work, as described, with chain, chain sheave and accessories, monkeys, nippers, trip gear and travelling wheels.

The cost of link reversing motions and duplicate feed to boiler will be found in the preceding list.

PRICES OF STEAM PILE DRIVING MACHINES, Fig. 2311.

Weight of monkey .. .. tons	1	1½
Price of machine complete as described	£185	£205
Approximate weight and measurements .. .. .. tons	8	10

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

PORTABLE STEAM PILE DRIVING ENGINES constructed as shown in Fig. 2312 were designed by the writer, for use on the Continent of Europe where the system adopted differs from that usual in this country. The difference consists in keeping the ground "alive" by a rapid succession of blows on the head of the pile.

To obtain this result, the chain barrel is loose on the shaft and is thrown in and out of gear by a large friction cone clutch at the end of the barrel. The cone is traversed by central worm gear (Appleby's patent) and connected to the steam stop valve in such a manner, that the steam is admitted for lifting and automatically shut off when the clutch is released, at the same time the fleeting of the chain is checked; the monkey is never disconnected from the rope or chain. Although no winch pile driver nearly equals this for frequency of stroke, it is questionable whether this system is so generally useful as that last referred to.

The undercarriage is of wrought iron; the wheels are plain or flanged and are arranged to swivel for altering the direction of traverse.

The capstan end is used for pitching piles, manipulating the leaders which guide the monkey, and for other purposes.

A water jet to the pile shoe greatly accelerates the descent of the pile. The appliances for this purpose—supplied by the writer—were first used in connection with the pile drivers now referred to.

The price of a pile driver Fig. 2312 to work a monkey weighing 14 cwt. is .. £210
,, ,, ,, ,, 16 to 20 cwt. is .. £240

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

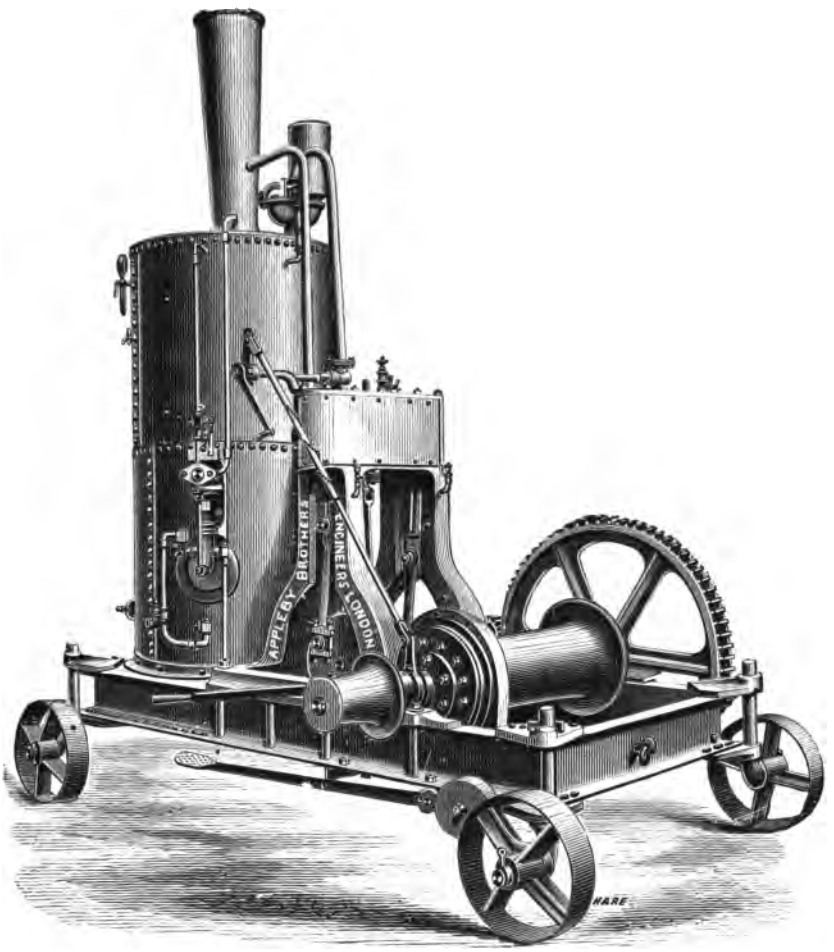


Fig. 2312

HAND POWER PILE DRIVING MACHINES, Fig 2313.—The pitch pine frame—usually 24 feet high—is provided with the top chain sheave, bearings and accessories, together with the ironwork and bolts to firmly tie the structure. The platform frame is fitted with flanged or plain wheels which can be swivelled in the direction desired.

The pile driving gear consists of a single purchase crab similar to Fig. 2319; the chain is of best tested quality and of ample length; the monkey is of the weight indicated below, with wrought iron loop for the nippers and the usual fittings; the trip gear to the nippers is worked from the platform, or automatically.

PRICES OF HAND POWER PILE DRIVERS, Fig. 2313.

Weight of monkey .. .. tons	½	¾	1
Price of machine 24 feet high	£36	£42	£50
,, extra height .. .. per foot	13/-	15/-	17/-
,, crab and ironwork only	£20	£25	£30

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

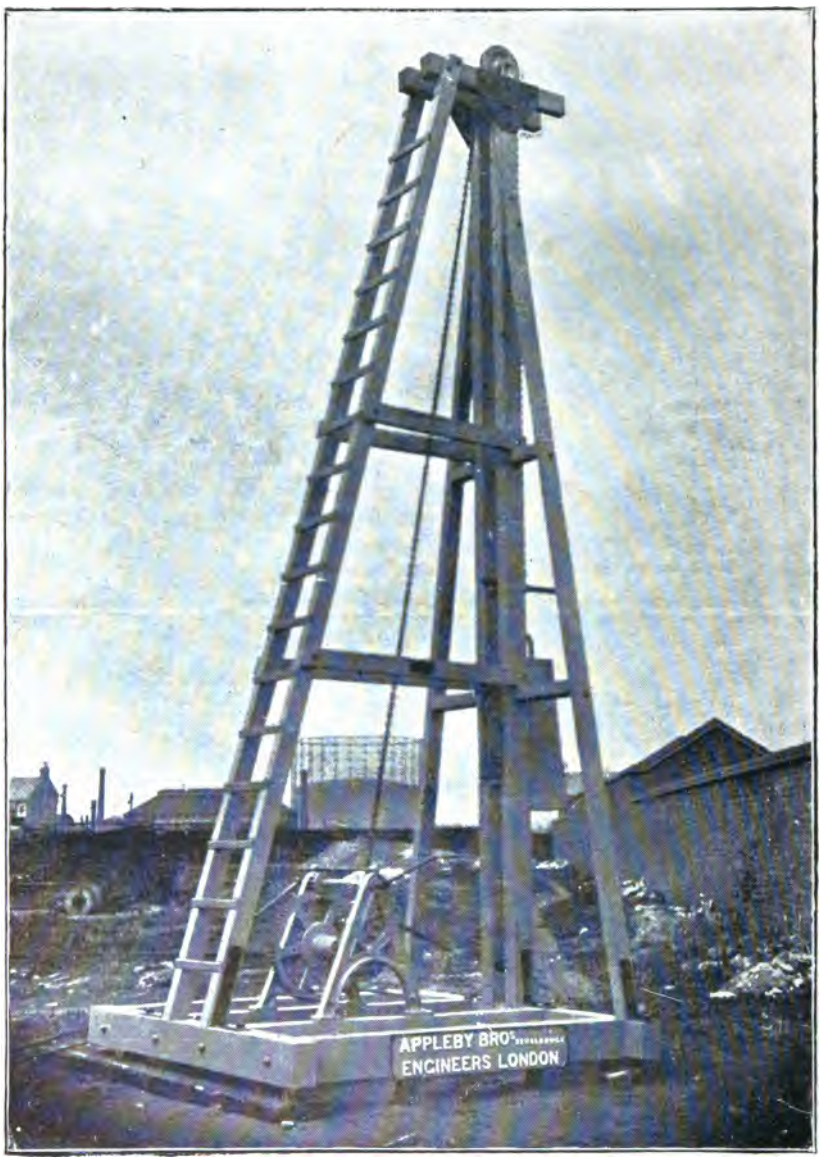


Fig. 2313

The above engraving is reproduced from a photograph of a machine 8 metres high (about 26 feet) to work a monkey weighing 750 kilogs. (about 15 cwt.)

The leaders, back ties, &c. were taken down after test and carefully marked for re-erection by native labour.

For description and prices see page 165.

STEAM AND HAND POWER CAPSTAN, Fig. 2314.—The capstan is driven by a pair of horizontal engines, and double spur gear actuating a worm which rotates a worm wheel on the post underneath the capstan ; the capstan being then driven by the pawls on its outer edge, as seen in the engraving.

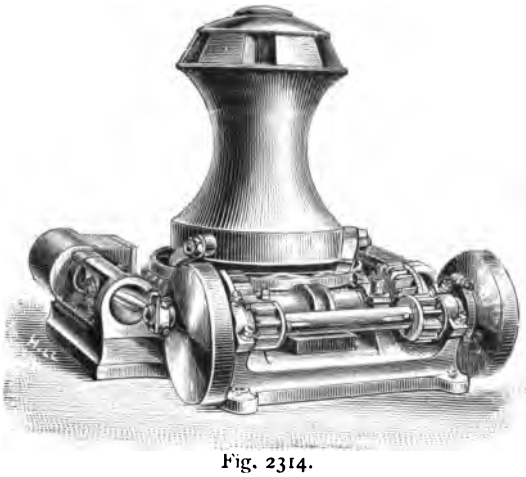


Fig. 2314.

When the capstan is required to work by hand the capstan bars are inserted and the head revolves freely on the post, being locked in any position by the pawls.

The bed plate which carries the above named machinery, and the wrought iron post or pivot around which the capstan rotates, is fixed immediately below deck, quay or floor level, or as illustrated. In the latter case a box is usually provided to protect the engines, &c.

The steam regulator is worked by a pedal which projects through the floor where convenient for the attendant, and the capstan is strong, compact and durable.

PRICES OF CAPSTANS, Fig. 2314.

Nominal horse power	5	6	8
Price of capstan	£88	£112	£130

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

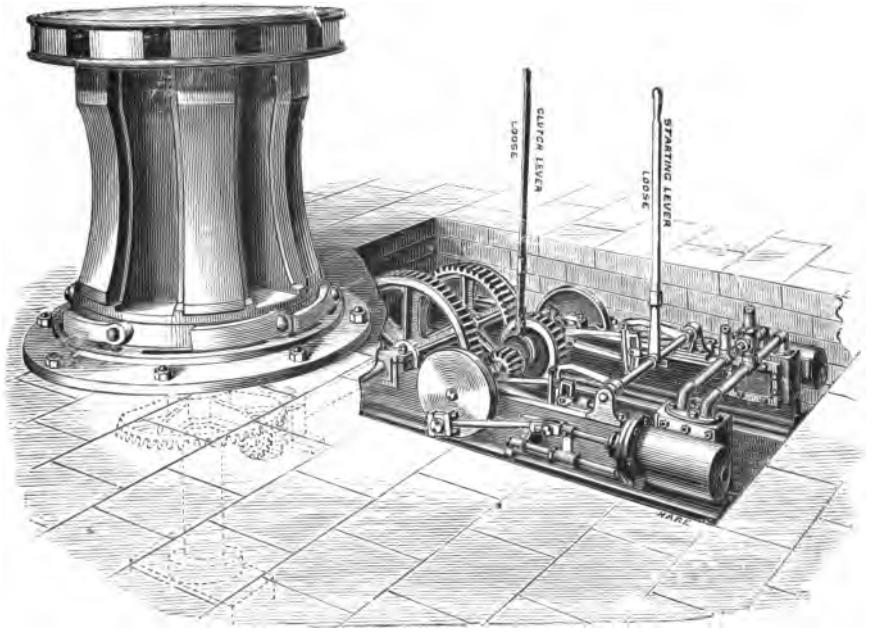


Fig. 2315

THE STEAM OR HAND POWER CAPSTAN, Fig. 2315, was built for use at the pier head of one of H.M. dockyards, and is driven by steam, or by manual labour in the usual manner. Steam is conveyed to the engines by an underground tube from an existing range of boilers.

The engines and gear are fixed slightly below quay level, and are covered by wrought iron chequered plate. The gear is arranged to give two speeds and powers respectively equal to a pull of 1 and 2 tons on the hawser. The levers controlling the reversing motions for changing the speeds or for disconnecting the gear, are removable and leave the surface flush for working by manual power.

The capstan is of the Admiralty pattern, with hard wood whelps and is carried on a wrought iron post. The top step and all other bearings are in hard gun metal of ample proportions.

The capstan is loose on its post and can be operated by hand power, with bars in the manner last described.

The cost of the capstan is about £265

ELECTRIC CAPSTANS.—The facility which the electric transmission of power affords for varying loads—with a consumption of power always in direct ratio with the work performed—must necessarily lead to the adoption of this system especially where electric power exists.

The arrangement of electric capstans is identical with those indicated in Figs. 2314 and 2315, the engines being replaced by a motor and are therefore not illustrated. It is necessary in making enquiries to state the conditions to be fulfilled, including the maximum and minimum loads, the speeds, and the pressure of current available, if any.

HYDRAULIC CAPSTANS.—These are referred to, together with other hydraulic plant, in Section V.

HAND POWER CAPSTANS.—The revolving head is plain, as shown in Fig. 2314, or has whelps cast on, as in Fig. 2315, and is carried on a wrought iron post of the requisite height and section. This is keyed in a base plate with a ratchet to receive the wrought iron pawls which are hung on turned wrought iron pins at the base of the revolving head.

The double purchase capstans are as above described, with the addition of gear which can be worked in single or double purchase, as desired.

The prices are for the capstan ready to fix, but do not include handspikes :—

PRICES OF HAND POWER CAPSTANS.

Height of revolving head .. .. inches	24½	28½	31	34	38	49
Diameter at base .. .. .. ,,	19	19	24	26	27	39
,, at centre .. .. .. ,,	12	12	13	15	18	24
Price of single purchase capstan	£4 10	£5	£7	£11	£17	£33
,, double ,, ,, ...	£8	£9	£12	£18	£27	£45

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

STEAM STEERING GEARS.—Although this subject scarcely comes under the category of hoisting machines, the construction of steering gears so closely resembles some of the winches referred to, that the leading types are briefly mentioned – without illustrations — but with approximate prices.

STEAM AND HAND STEERING GEARS WITH HORIZONTAL ENGINES.—The engines, gear, spirally grooved chain barrel and indicator, are carried on a base plate which is mounted on a pair of cast iron standards, ready to bolt to the deck of the steamer. The motion of a lever changes from steam to hand, and the arrangement of the machinery affords complete facility for examination and maintenance.

The steam pressure is assumed to be not less than 80 lbs. per square inch, but all parts are equal to a working pressure of 150 lbs.

The prices include all accessories, and the gears are of ample power for steamers of the undernamed tonnage :—

PRICES OF STEERING GEARS WITH HORIZONTAL ENGINES.

Tonnage of steamer	1000	2000	3000	4000
Price of gear for hand and steam ..	£110	£122	£133	£150
,, ,, for steam only	£105	£116	£127	£144

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

STEAM AND HAND STEERING GEAR WITH VERTICAL ENGINES.—The engines and all working parts are carried in a pair of side frames with base plate for bolting to the deck, the whole being enclosed in a wrought iron casing forms a neat, compact and efficient apparatus for yachts and small steamers. The steering chain coils around a spirally grooved barrel and the indicator is above the casing. A clutch and lever are provided for changing from steam to hand steering.

The steam pressure is assumed to be between 80 and 150 lbs. per square inch.

PRICES OF STEERING GEAR WITH VERTICAL ENGINES.

Tonnage of steamer	250	500	1000
Price of gear for steam or hand	£81	£92	£103
,, ,, for steam only	£78	£89	£99

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HAND POWER CRABS.—Figs. 2316 to 2320 illustrate the types in general use, and attention is directed to those with wrought iron or mild steel frames as being preferable for many purposes, from the fact that they are (practically) unbreakable.

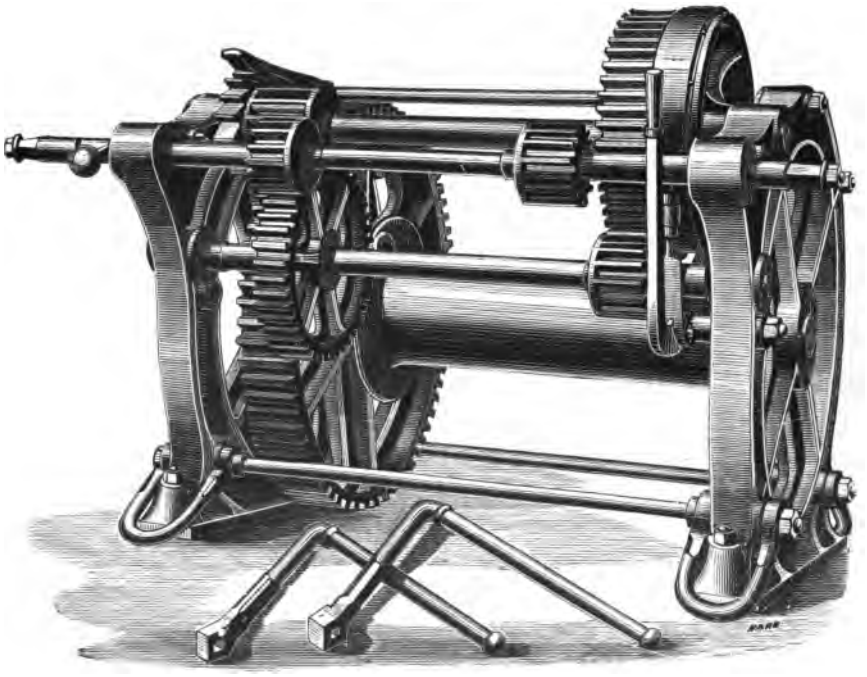


Fig. 2316

The trebie purchase crabs, Fig. 2316—built for H. M. Government for moving heavy guns and their accessories—have strong cast iron side frames and feet and are provided with Lowmoor iron shackles for anchoring the crab for temporary use. In this case weight is obviously an advantage.

The pinions are of cast steel and the bearings are lined with hard gun metal; all the proportions are ample for lifting the specified load of 5 tons direct from the barrel and the fitting and finish of the crab is similar to that in the best machine work.

The price of the crab is about ... ... £70.

The approximate weight is 5 tons.

TREBLE PURCHASE CRAB WITH WROUGHT IRON FRAMES.

—The sides are of ample section and stiffened by angle iron frames. The bosses which carry the bearings are rivetted to the side frames and bushed with gun metal. The main wheel is double shrouded and keyed on the chain barrel and the crab is complete with screw brake on the second motion shaft, ratchet wheel, and wrought iron pawl The arrangement of gear is (generally) as shown in Fig 2316.

PRICES OF TREBLE PURCHASE CRABS WITH WROUGHT IRON SIDES.

To lift direct from the barrel ... tons	7	8	10	12	15
Price of crab	£55	£65	£75	£90	£110

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

DOUBLE PURCHASE CRAB WITH WROUGHT IRON SIDES,

to lift (up to) 6 tons direct from the barrel, have strong iron sides with angle iron along the bottom to form a foot. The bosses, screw brake, &c., are arranged as above described.

PRICES OF DOUBLE PURCHASE CRABS WITH WROUGHT IRON SIDES.

To lift direct from the barrel ... ... tons	3	4	5	6
Price of crab	£30	£35	£40	£45

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

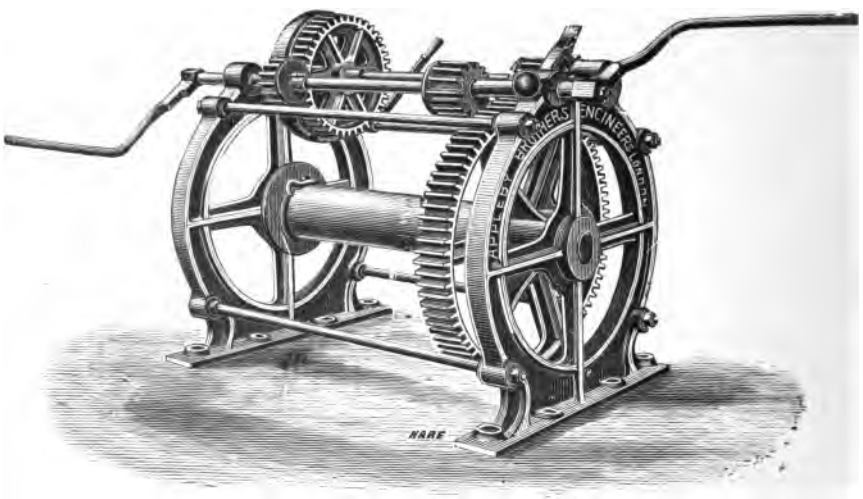


Fig. 2318

DOUBLE PURCHASE CRAB WITH CAST IRON CIRCULAR SIDES.—Fig. 2318 represents a form of crab largely used in Government yards, railway service, &c. The strongly ribbed circular frames were designed to protect the gear when roughly handled, and have fully answered this purpose.

The crab is complete with handles, strap brake and lever, or with screw brake as mentioned below. **Warping drums** can be added at a cost of 20/- to 30/- each.

PRICES OF CRABS WITH CIRCULAR SIDES, Fig. 2318.

To lift direct from barrel	tons	1	1½	2	2½	3	4
,, with 2 and 3 sheave blocks ..	,,	5	8	10	12½	15	20
Price of crab	..	£8	£9	£10	£12	£16	£23
,, extra for screw brake	..	12/-	15/-	22/-	23/-	24/-	25/-
,, ,, gun metal bushes	..	21/-	23/-	25/-	27/-	34/-	42/-
,, best tested chain.. ..	per foot	-/8	-/10	1/-	1/2	1/4	1/6

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

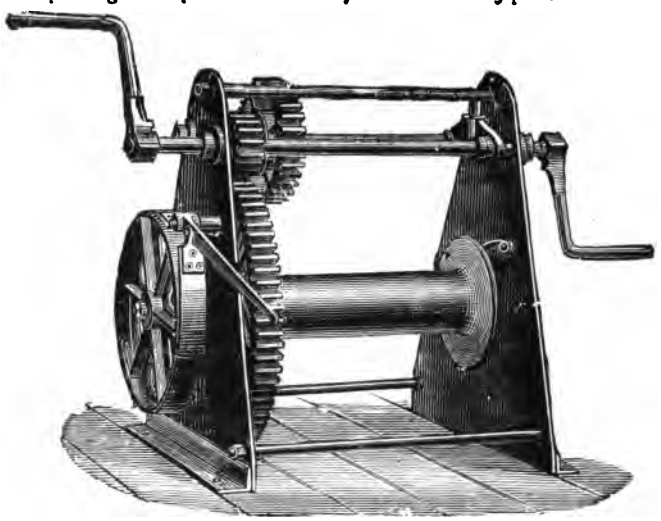


Fig. 2320

The **HAND CRABS** Figs. 2319 and 2320, are suitable for general use, and are usually supplied with the jibs, Figs. 2321 to 2323. For heavy work the sides are made of wrought iron instead of cast iron, at a slightly increased cost, as shewn below. The winch is supplied complete with handles, ratchet, and pawl, single and double purchase gear and stops for keeping the pinions in their proper position; for loads of one ton and under, single purchase gear only is provided. The crane chain is of best quality tested to Admiralty proof strain, and the undernamed prices include swivel hook of treble best iron, ball and attachment to winch barrel.

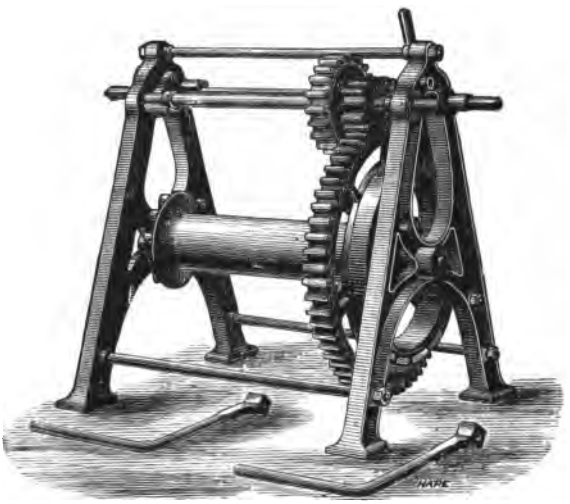


Fig. 2319.

PRICES OF HAND CRABS, Figs. 2319 and 2320, AND ACCESSORIES.

To lift direct from the barrel .. tons	1	1½	2	3	4
,, with 2 and 3 sheave blocks .. ,,	5	7	10	15	20
Price of crab, Fig. 2319	£4 15	£6 10	£7 10	£10 10	£18
,, ,, Fig. 2320	£6 10	£8 10	£9 10	£12 10	£20
Extra for screw brake	10/-	15/-	20/-	22/-	25/-
,, gun metal bushing	18/-	20/-	23/-	30/-	38/-
Price for chain hooks, &c. .. per foot	8½d.	10½d.	11½d.	1/6	1/9
Size of chain .. .. .. inch	7/16	½	9/16	¾	18/16

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

HAND POWER CRABS FOR WIRE ROPE are precisely similar to Figs. 2319 and 2320, excepting that the drums are of the dimensions requisite for coiling flexible steel wire rope of the sizes mentioned below.

For prices of screw brakes, &c, see the preceding page.

HAND POWER CRABS FOR STEEL WIRE ROPE.

To lift direct from barrel .. .. tons	½	¾	1¼	1½	2
Diameter of barrel .. .. .. inches	10	11½	12½	13¾	15
Circumference of rope .. .. ,,	1½	1¾	2	2¼	2½
Length of rope coiled .. .. feet	70	75	80	90	100
Price of crab with cast iron frames ..	£6	£7	£8 5	£10 10	£18
,, ,, wrought iron frames ..	£8	£9	£10 5	£12 10	£20
Extra for screw brake	10/-	10/-	20/-	23/-	25/-
,, gun metal bushing	17/-	21/-	24/-	30/-	38/-
Price of steel wire rope .. per yard	-/8	-/11	1/2	1/7	1/10

The cost of packing for shipment and delivery f.o.b. is 5 per cent.

HAND POWER WALL CRABS.—The gear and fittings are the same as are used for crabs of equal power, Fig 2319, but they are carried in a pair of cast iron brackets with feet to bolt to a wall or timbers.

PRICES OF HAND POWER WALL CRABS.

To lift direct from the barrel .. .. tons	1	1¼	1½	2
Price of crab, double purchase gear	£4 10	£5	£6	£7

CRANE JIBS, Fig. 2321.—The jib is made of round wrought iron and is fitted with chain sheave working on a turned steel pin, top bearing with a pair of guide rollers and inside chain sheave; the bottom bearing for the foot of the jib is complete with wall plate and bolts are provided for a wall 14 inches thick.

WINCHES AND CHAINS.—The hand power winch referred to below is of the type Fig. 2319, and is complete with handles, strap brake and lever.

The chain is of best quality, tested to 10 per cent. above Admirality proof strain, and the hook is of treble best iron with swivel.

PRICES FOR CRANE JIBS, Fig. 2321 AND ACCESSORIES.

To carry .. tons	½	½	1	1	1½	1½	2	2	3	3
Radius .. feet	3	4½	3½	4½	3½	5	4	7	5	9
Height .. ,,	4½	5	5	5½	5	6½	6	8	6½	11
Price of jib .	£5 15	£6 10	£7 10	£9	£9 15	£12 5	£13 5	£16 10	£18 15	£21 15
,, winch ..	£3 5	£3 5	£5 5	£5 5	£6 10	£6 10	£7 10	£7 10	£8 10	£8 10
,, chain, pr. ft.	-/5¼	-/5¼	-/7	-/7	-/8	-/8	-/9¼	-/9¼	-/10½	-/10½

Packing for shipment and delivery f.o.b. usually costs about 5 per cent.

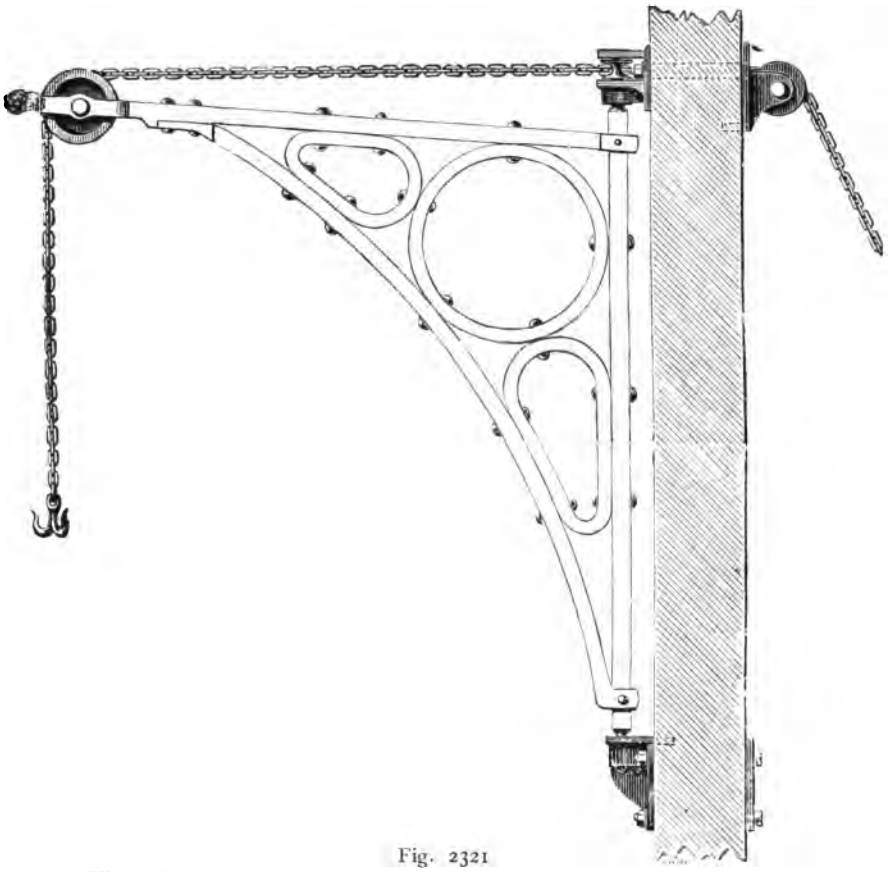


Fig. 2321

Fig. 2322

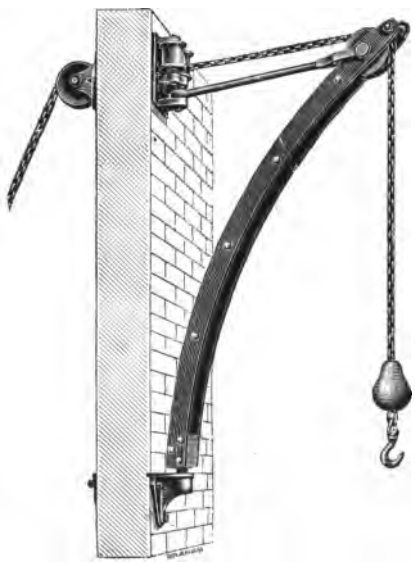


Fig. 2323

CRANE JIBS, Figs. 2322 and 2323 are inexpensive, and the latter can be used where the height above the top of doorway is insufficient for one of the construction shown in Fig. 2322, as Fig. 2323 is usually placed at the side of doorway.

The jibs are built up of wrought iron bars, with distance pieces between them, and are provided with guide rollers chain sheave, wall plates and bolts.

Prices for suitable crab winches and chain will be found on page 172.

PRICE OF CRANE JIBS, Fig. 2322.

To carry .. .. tons	½	½	1	1	1½
Radius	3ft.	4ft. 6in.	3ft. 6in.	4ft. 6in.	3ft. 6in.
Height	1ft. 3in.	1ft. 6in.	1ft. 6in.	1ft. 9in	1ft. 9in.
Price	£3 15 0	£4 14 6	£5 12 6	£6 12 0	£7 8 6

To carry .. .. tons	1½	2	2	3	3
Radius	5ft.	4ft.	7ft.	5ft.	9ft. 6in.
Height	2ft.	2ft.	2ft. 6in.	2ft. 3in.	3ft. 2in.
Price	£7 17 6	£8 9 0	£10 0 0	£12 4 0	£14 10 0

Packing for shipment and delivery f.o.b. 5 per cent. extra.

PRICES OF CRANE JIBS, Fig. 2323.

To carry .. .. tons	½	½	½	1	1
Radius	3ft.	4ft.	5ft.	3ft.	4ft.
Height	5ft.	5½ft.	6ft.	5ft.	5½ft.
Price	£3 12 0	£4 7 6	£4 19 0	£5 7 6	£5 19 0

To carry .. .. tons	1	2	2	2	3
Radius	5ft.	3ft.	4ft.	5ft.	5ft.
Height	6ft.	5ft.	5½ft.	6ft.	6ft.
Price	£6 7 6	£7 7 6	£8 2 6	£8 18 0	£11 10 0

Packing for shipment and delivery f.o.b. 5 per cent. extra.

Fig. 2324.

Fig. 2325.

Fig. 2326.

Fig. 2327.

PULLEY BLOCKS "London pattern," Figs. 2324 to 2327—The side plates and strengthening strips are of mild steel and the crosshead and hook are wrought iron forgings. Blocks with sheaves exceeding 9 inches diameter have swivelling loops. The cost with fixed loop is much lower.

The size of crane chain each block will take is given below; the width of the groo ndicates the diameter of rope to be used.

For the lifting power of blocks, see table below.

Galvanized blocks.—Add 20 per cent. to the subjoined prices.

PRICES OF PULLEY BLOCKS (**Iron Sheaves**) Fig. 2324 to 2327.

Diameter of sheave .. inch	5	6	7	8	9	10	11	12	14	16
Width of groove .. ,,	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3 1/4
Size of chain .. .. ,,	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8
Price, 1 sheave, Fig. 2324 ..	6/3	7/6	9/6	12/6	20/-	33/-	48/-	58/-	76/-	140/-
,, 2 ,, Fig. 2325 ..	9/6	11/6	16/-	22/6	32/-	54/-	90/-	112 -	146/-	240/-
,, 3 ,, Fig. 2326 ..	13/-	16/-	22/-	32/-	42/6	76/-	118/-	152/-	205/-	340/-
,, 4 ,, ...	16/6	21/-	31/-	45/-	65/-	120/-	176/-	230/-	340/-	500/-
,, Snatch block, Fig. 2327	11/6	13/6	16/-	21/-	30/-	43/-	60/-	84/-	100/-	148/-

Pulley blocks with brass sheaves but otherwise as above described and to carry the same working load as blocks with iron sheaves.

PRICES OF BLOCKS, Fig. 2324 to 2327, WITH BRASS SHEAVES.

Diameter of Sheave .. inches	5	6	7	8	9	10	11	12	14	16
Price, 1 sheave, Fig. 2324 ..	11/3	13/9	19/-	25/-	38/9	56/-	78/-	96/-	146/-	255/-
,, 2 ,, Fig. 2325 ..	19/6	24/-	33/-	47/6	69/6	100/-	150/	188/-	286/-	470/-
,, 3 ,, Fig. 2326 ..	28/-	35/-	47/-	82/-	99/-	145-	208/-	266/-	415/-	685/-
,, 4 ,, ...	37/-	46/-	65/-	95/-	140/-	212/-	296/-	382/-	620/-	960/-
,, Snatch block, Fig. 2327	17/-	20/-	25/-	34/-	49/-	66/-	90/-	122/-	170/-	263/-

Fig. 2328.

GIN BLOCKS OR WHIP GINS, Fig. 2328. consist of a wrought iron hook and frame, with turned steel pin carrying a grooved pulley of the width given below.

PRICE OF GIN BLOCKS, Fig. 2328.

Diameter of sheave .. inches	6	8	10	12	14	16
Width of groove .. ,,	1	1 1/8	1 1/8	1 1/8	1 1/2	1 1/2
Price of block	4/6	7/9	9/-	10/9	11/6	16/-

LIFTING POWER OF BLOCKS.—The following table gives the **test** load for pulley blocks, but the **working** load should not exceed about half the test load. A sheave 9 inches diameter carries a test load of 35 cwt.. and. if 2 and 3 sheave blocks are used, we have 5 parts × 35 = 175 cwt. or 8 3/4 tons ; the safe working load. therefore, is about 4 1/4 tons.

Diameter of sheave . inches	5	6	7	8	9	10	11	12	14	16
Test load each sheave cwts.	10	12	18	27	35	48	60	75	90	120

DIFFERENTIAL PULLEY BLOCKS.—Fig. 2329 represents the well-known Weston block, and Fig. 2330 a Moore block. Fig. 2331 is a Pickering block, and Fig. 2332 is a Pickering sack hoist. Each of these (although differing in details) sustains the weight, and one man can lift the maximum load.

The working load should not exceed about two-thirds to three-fourths that given as the test load.

Lengths of Chain —The length of lifting chain required for blocks of the types Fig. 2329 to 2331, is double the height of lift, plus 6 to 10 feet ; the hauling chains must be twice the height of lift.

Fig. 2329.

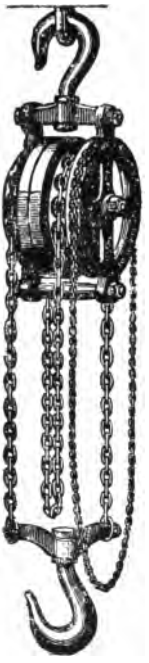


Fig. 2330.

Fig. 2331.

Fig. 2332.

The prices of chains include the swivel hooks and all accessories.

PRICES OF WESTON DIFFERENTIAL BLOCKS, Fig. 2329.

Test load .. .. tons	2	3	4	5	6	8	10
Price of blocks	£2 15	£3 5	£4	£5 10	£7	£9	£12
,, lifting chain per foot	-/9	-/10	-/11	1/-	1/3	1/6	1/9
,, hauling ,, ,,	-/6	-/6	-/6	-/7	-/7	-/7	-/8

PRICES OF MOORE SELF SUSTAINING BLOCKS, Fig. 2330.

Test load .. .. .. tons	1	2	3	4	5	7½	10
Price of block with hauling chain ..	£2	£2 17	£4 5	£5 10	£7	£11 10	£16 10
,, lifting chain .. per foot	1/6	1/8	2/3	2/3	2/6	5/-	7/6

PRICES OF PICKERING DIFFERENTIAL BLOCKS, Fig. 2331.

Test load .. .. .. tons	1	2	3	4	6	8	10
Price of block	£2	£3	£4 5	£5 10	£8	£10	£15
,, chains .. per foot of lift	3/-	3/4	4/6	4/6	5/-	6/-	9/-

THE PICKERING HOIST Fig. 2332 is adapted for handling sacks, bales or other packages ; the brake—mentioned below—is controlled by a rope, and is very useful for lowering into trucks, trolleys, &c.

The length of chain required, is three times the height of lift.

PRICES OF PICKERING HOIST, Fig. 2332.

Test load .. .. cwts.	2½	5	7½	10
Price of hoist	15/-	£1	£1 5	£1 10
,, ,, with brake	£1 5	£1 10	£1 15	£2
,, chain	-/7	-/7	-/8	-/8

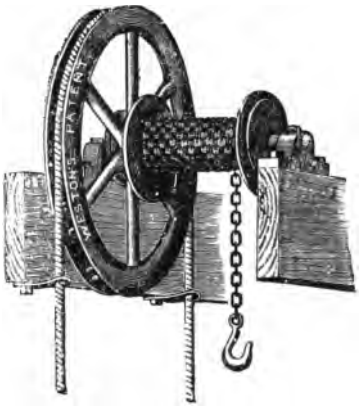


Fig. 2333.

WESTON SAFETY HOIST, Fig. 2333. --When the rope wheel is reversed the load begins to descend at a moderate speed, and is kept in motion by occasionally pulling at the rope. If the load be allowed to run, it will check itself gradually until it stops, and if the rope is suddenly "let go" whilst lifting, the load will remain suspended in its then position.

The beams which carry the bearings should be about 16 inches apart, and provision is required for the guides which keep the hauling rope in position.

The lifting chain should be about 3 feet longer than is necessary to reach from the bottom floor to the chain barrel to allow for coiling. The hauling rope is about twice the length of the lifting chain.

The price of the hoist tested with 2½ cwt. is £3 15 0
The price of best tested lifting chain with hook is .. .. 5d. per foot
The price of hauling rope is 3d. ,,

GEARED DOUBLE SAFETY HOISTS are similar to Fig. 2333, but have single purchase gear and double hooks—one ascending whilst the other is lowering—if desired, but they usually work with single chain.

HYDRAULIC JACKS, Figs. 2334 to 2336.—The proportions of the ram and lever admit of the maximum loads being lifted by one man and with about the same effort. The pumps are of gun-metal and fitted with wrought iron levers.

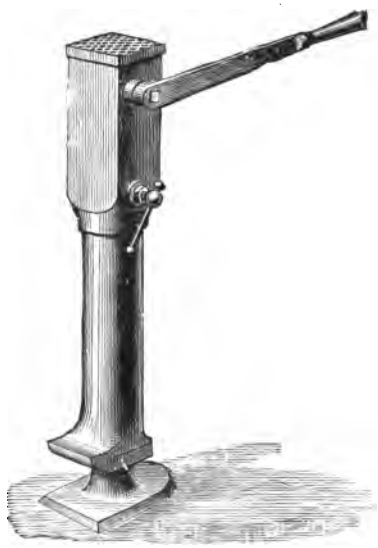


Fig. 2334

The test load, to which the jacks are submitted, is in all cases 25 per cent. more than the lifting power specified.

HYDRAULIC LIFTING JACK, Fig. 2334.—The ram is of wrought iron and lifts with the head or foot as convenient.

HYDRAULIC TRAVERSING JACKS are as above described, but mounted on a base plate with wrought iron traverse screw and lever for working it, as shown in Fig. 2337.

Mode of Working.—Perhaps it is scarcely neccessary to say that the screw stop valve in the head is closed before commencing to work the lever for lifting, and that the load is lowered, at any speed desired, by slackening (unscrewing) the above named valve.

When the cistern needs to be re-filled, about a quarter of an ounce of soda should be dissolved in distilled, or clean rain water, and the cistern filled through the screw hole near the head of the jack.

PRICES OF HYDRAULIC LIFTING JACKS, Fig. 2334.

Lifting power .. tons	4	6	8	10	15	20	30	40	50	60
Height when down ins.	23	24	26	27	28	28	29	29	29	29
Stroke of ram .. ,,	10	10	11	12	12	12	12	11	11	10
Price of jack	£3 15	£4	£4 10	£5	£6	£6 10	£7 10	£9	£10 10	£12 10
Approximate weight lbs.	52	68	72	88	105	130	165	220	260	335

The test load is 25 per cent. more than the "lifting power."

PRICES OF HYDRAULIC LIFTING AND TRAVERSING JACKS.

Lifting power .. tons	4	6	8	10	15	20	30	40	50	60
Height when down ins.	26	27	29	30	31	31	32	32	33	33
Stroke of ram .. ,,	10	10	11	12	12	12	12	11	11	10
Traverse of jack ,,	6½	7	7	10	12	12	12	17	17	18
Price of jack .. ,,	£5 15	£6 5	£7	£7 10	£9	£10	£13 10	£15 10	£20	£22 10
Approx. weight lbs.	95	105	112	130	165	215	310	345	490	565

The test load is 25 per cent. more than the "lifting power."

The cost of packing for shipment and delivery f.o.b. is about 5 per cent.

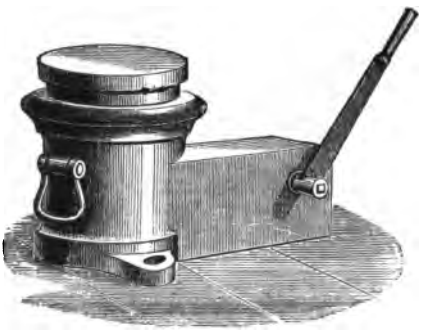


Fig. 2335.

HYDRAULIC SHIP JACKS.—Fig. 2335 represents the type of jack largely used in ship and bridge building yards, arsenals, engineers' works, &c

SPECIALLY CONSTRUCTED JACKS have been successfully used for many purposes, amongst which may be mentioned a set of plant (designed by the writer) for launching bridges.

The case, ram and head are of cast steel, the latter having side frames which carry a revolving cylindrical head with heavy steel spindle which revolves freely in the side frames. The pumps are detached and one set supplies pressure to a pair of jacks.

The jacks were fixed temporarily on each pier and supported the bridge until the launching had been completed and the piers built so as to permanently carry the main girders. This arrangement will be illustrated and described in Section V.

The following prices relate to the jacks now illustrated (Fig 2335). They are provided with bow handles for moving, and with wrought iron lever to work the pumps.

A pressure gauge costs £4 4s.

A safety valve costs £1 15s.

HYDRAULIC SHIP JACKS, Fig. 2334.

Lifting power .. .. tons	12	20	35	50	70	100	150	200
Height when down .. inches	11	11	11	12	12	13	13	13
Stroke of ram .. .. ,,	6	6	6	6	6	6	6	6
Price of jack	£5	£5 15	£7 10	£9 5	£15	£19	£22 10	£26 10
Approximate weight .. lbs.	95	100	135	200	270	390	530	620

The test load is 25 per cent. more than the lifting power.

The cost of packing for shipment and delivery f.o b. is about 5 per cent.

Fig. 2336.

THE HYDRAULIC PULLING JACK, Fig. 2336, pulls vertically or horizontally, and the pump lever is worked by one man.

PRICES OF HYDRAULIC PULLING JACKS, Fig. 2336.

Power of jack ... ... tons	2	4	6	8	10
Stroke of ram . . .. inches	24	24	24	24	24
Price of jack	£9	£11 10	£14	£16	£18
,, per foot (extra stroke)	£3	£3	£3 10	£4	£4
Approximate weight ... ... lbs.	60	70	90	120	180

THE SCREW AND RACK JACKS, Figs. 2337 to 2347, are tested with a load 25 per cent. beyond the lifting power mentioned in connection with each engraving.

Special designs as regards height of lift, shape of head and foot, &c., must occasionally (but rarely) be made.

Fig. 2337.

Fig. 2338.

Fig, 2339.

TRAVERSING SCREW JACK, Fig. 2337.—The head is fitted with a gun metal nut, the legs are of wrought iron, and the base of malleable cast iron. The lifting and traversing screws are of wrought iron, the latter working in a gun metal nut, and both are fitted with ratchets and sockets. The jack can be detached from the slide for ordinary work.

PRICES OF TRAVERSING SCREW JACKS, Fig. 2337.

Lifting power ... ... tons	6	8	10	15	20
Height when down ... ... inches	20	20	21	22	23
Traverse of jack ... ... ,,	7	7	10	12	12
Price of jack	£3 3	£3 5	£4	£4 15	£7 10

HALEY JACK, Fig. 2338. —The case is of wood with wrought iron front plate, and lifts at head or foot.

Fig. 2339 has a malleable cast iron case, and is preferable for use in hot and dry climate ; in other respects it is as above described.

PRICES OF HALEY JACKS, Fig. 2338.

Lifting power ... ... tons	2	4	6	8	10	12
Height when down ... ... inches	28	30	31	33	33	35
Price of jack	£2 6	£2 17	£3 5	£4	£4 8	£5 12

PRICES OF HALEY JACKS, Fig. 2339.

Lifting power ... ... tons	2	4	6	8	10	12
Height when down ... ... inches	25	26	28	30	31	33
Price of jack	£2 15	£3 6	£3 17	£4 13	£5 5	£6 15

Fig. 2340. Fig. 2341. Fig. 2342. Fig. 2343. Fig. 2344.

RACK AND PINION JACK, Fig. 2340.—The case is of wood, faced with iron on the inner side; the double purchase wheels and pinions are of wrought iron, case hardened, and the jack lifts from head or foot.

PRICES OF RACK AND PINION JACKS, Fig. 2340.

Lifting power ... ... tons	4	6	8	10	15
Height when down ... ... inches	30	30	32	34	36
Price of jack	£6	£7 5	£8 5	£9 10	£14

RATCHET BOTTLE JACK, Fig. 2341.—The case is of wrought iron, with brass nut in the neck, or of malleable cast iron, and the neck is fitted with a double ratchet for working in a limited space.

PRICES OF RATCHET BOTTLE JACKS, Fig. 2341.

Lifting power ... ... tons	2	4	6	8	10	12	15
Height when down ... ... inches	8	14	19	22	21	21	22
Price with wrought iron case	16/-	£1 3	£1 12	£1 18	£2 5	£2 10	£3 5
,, ,, malleable ,, ,, ...	12/-	17/-	£1 4	£1 8	£1 15	£2 0	£2 15

SCREW BOTTLE JACKS—Figs. 2342 and 2344 represent respectively a malleable and wrought iron case, with brass nut for the lifting screw. These jacks and Fig. 2343 are much used in stowing bales, bags, &c., and are frequently called "Cotton Screws."

PRICES OF SCREW BOTTLE JACKS, Figs. 2342 and 2344.

Lifting power ... ... tons	2	4	6	8	10	12	15
Height when down ... ... inches	10	15	20	22	22	22	23
Price with malleable iron case ...	8/-	13/-	19/-	£1 2	£1 9	£1 12	£2 7
,, ,, wrought ,, ,, ...	10/-	19/-	£1 7	£1 12	£1 19	£2 2	£2 17

TRIPOD SCREW JACKS, Fig. 2343.—The legs and base are of wrought iron and the neck is fitted with a gun-metal nut.

The Ratchet referred to below is similar to that shown in Fig. 2341.

PRICES OF TRIPOD JACKS, Fig. 2343.

Lifting power ... ... tons	2	4	6	8	10	12	15
Height when down ... ... inches	10	15	20	22	22	22	23
Price of jack Fig. 2341...	12/-	19/-	£1 8	£1 12	£2 0	£2 5	£3 0
,, ,, with ratchet	16/-	£1 3	£1 13	£1 18	£2 6	£2 13	£3 8

Fig. 2345.

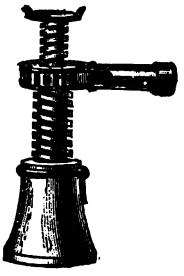


Fig. 2346.

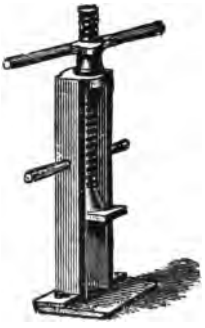


Fig. 2347.

TELESCOPE TRAVERSING SCREW JACK, Fig. 2345.—The case is made of malleable cast iron and fitted with external and internal lifting screws, whereby the height when down is reduced and the rise of screw increased. The base is of malleable iron and a ratchet is provided for the head and the traverse screw.

PRICES OF TELESCOPE TRAVERSING SCREW JACKS, Fig. 2345.

Lifting power ... ... tons	10	15	20
Height when down ... ... inches	16½	19¼	21
Rise of screw ... ... ,,	8	10	12½
Traverse of jack ... ... ,,	12	12	12
Price of jack ... ... ,,	£5 10	£7	£9 10

THE TELESCOPE LIFTING JACK, Fig. 2346, is as last described but without base and traversing gear.

PRICES OF TELESCOPE LIFTING JACKS, Fig. 2346.

Lifting power ... ... tons	3	4	5	6
Height when down ... ... inches	11	12½	15½	20
Price of jack	£2 10	£3	£3 10	£4

THE PLATE LAYERS JACK, Fig. 2347, consists of a wrought iron frame with screw and lever, and lifts from the lower end of the screw ; the range of traverse is about 16 inches.

PRICES OF PLATE LAYERS JACKS, Fig. 2347.

Diameter of screw .. .. inches	1¼	1½	1⅝	2
Height when down .. .. ,,	25	25	25	26
Price of jack	£1 5	£1 15	£2	£2 5

SHORT LINK CRANE CHAIN, referred to in the following table, is tested to 10 per cent beyond Admiralty proof strain.

Lloyd's Test.—If a certificate of Lloyd's test is required the cost varies from 3/- to 1/6 per cwt., but the charge to cover the fee paid for testing, cost of delivery, &c., is usually about 2/- per cwt.

The Prices —The chains are made of special quality of iron and the prices are subject to variations in the cost of materials, &c.

APPROXIMATE PRICES, WEIGHTS, &C., OF BEST CRANE CHAIN.

Size of chain .. .. inch	⅜	7/16	½	9/16	⅝	¾	⅞	1	1⅛	1¼
Weight per foot .. .. lbs.	1·88	2·35	3	3·69	4·32	6	8·32	10·69	13·125	15·75
Proof strain .. .. cwts.	35¾	49½	66	82½	101¾	148½	200¾	264	332⅝	412½
Working load .. .. ,,	20	27	37	47	57	85	110	140	180	220
Price .. .. per foot	-/5¼	-/7	-/8	-/9¼	-/10½	¼	1/6	1/10½	2/4	2/10

STEEL WIRE ROPES.—The strands—each with hemp core—are wound around a central hemp core. The strength and durability of a rope are due to the quality of steel used and the number of wires in each strand, every wire being tested to a high tensile strain.

Extra special flexible plough steel wire rope is necessarily the most expensive, but it is the most reliable and usually the most economical for winding and hauling, and is exclusively referred to in the following tables.

Diameters of winding drums and pulleys.—It is well known that these should be in relation with the quality and size of rope and the speed at which it will work, but the cost of renewing a rope is often of minor importance compared with facilities afforded by working with smaller drums and pulleys than the "mean diameters" given in the subjoined tables.

Testing wire ropes.—Each wire having been tested in the process of manufacture, a final test—such as that to which chains are submitted—is unnecessary and undesirable.

Winding and hauling.—The following information—used in conjunction with that given at page 134—will suffice for determining the size of rope suitable for lifting vertically and for hauling on different gradients.

Maintenance of chains and steel wire ropes.—The life of chains and ropes is greatly increased by proper lubrication.

APPROXIMATE WEIGHT, STRENGTH, &C., OF ROUND FLEXIBLE STEEL WIRE ROPE.

Circumference .. .. .. inches	1	1¼	1½	1¾	2	2¼	2½	2¾	3
Diameter .. .. .. ,,	·318	·397	·477	·557	·636	·716	·795	·875	·954
Weight per yard .. .. lbs.	·44	·63	·88	1·3	1·63	2·13	2·5	3·	3·8
Breaking strain .. .. tons	3½	5½	8	10½	13¾	18	22	27¼	32¾
Working load .. .. .. cwts.	8¼	14	20	26	34	45	54	68	82
Price .. ..per yd.	-/4	-/5½	-/8	-/11	1/2	1/7	1/10	2/3	2/9
,, steel thimbles and splicing each	3/6	3/6	4/-	4/-	4/6	4/9	5/-	5/3	5/6
,, conical sockets .. .. ,,	9/6	9/9	10/-	11/-	12/-	15/-	18/6	21/-	22/6
Minimum diameter sheaves .. inches	1	1½	1¾	2¼	3	3¾	4¾	5¾	6¾
Mean ,, ,, .. ,,	6	7	9	10	12	13	15	16	18

ROUND WIRE ROPES—Continued.

Circumference .. .. .. inches	3¼	3½	3¾	4	4¼	4½	5	5½	6
Diameter .. .. .. ,,	1.03	1.11	1.19	1.27	1.35	1.43	1.59	1.75	1.9
Weight per yard .. .. lbs.	4.4	5	5.9	6.5	7.5	8.5	10.5	12.5	15.
Breaking strain .. .. tons	37	43¼	48¾	55¾	63½	71¾	88¾	107	126
Working load .. .. .. cwts.	93	108	122	139	159	179	220	267	315
Price .. .. per yd.	3/-	3/4	3/10	4/2	4/10	5/8	6/9	8/6	10/-
,, steel thimbles and splicing each	5/9	5/9	6/-	6/-	6/3	6/6	6/9	7/-	7/6
,, conical sockets .. .. ,,	25/-	26/6	27/-	28/-	28/6	29/-	31/6	33/-	34/6
Minimum diameter sheaves .. inches	8	9	10½	12	13	15	19	23	27
Mean ,, ,, .. ,,	19	21	22	24	25	27	30	33	36

The cost of packing for shipment and delivery f.o.b. is usually about 5 per cent.

APPROXIMATE WEIGHT, STRENGTH, &C., OF FLAT STEEL WIRE ROPES.

Size .. .. inches	2½ × ⅛	2¾ × ⅛	3 × ⅛	3½ × ⅛	3½ × ⅛	3¾ × 1/16	4 × 1/16
Weight per yard .. .. lbs.	6	7	8	9	10	11⅛	12⅛
Breaking strain .. .. .. tons	47	54	74	81	93	111	120
Working load .. .. .. cwts.	94	108	148	162	186	222	240

BEST HEMP ROPE—The "working loads" in the following tables are those which a single rope of the best quatity will lift vertically.

Common hemp rope weighs about one-third less, and the working load should be quite one-third less than best rope of equal size will carry, and is much less durable.

APPROXIMATE WEIGHT, STRENGTH, &C., OF BEST HEMP ROUND ROPE.

Circumference .. .. .. inches	2	2¼	2½	2¾	3	3¼	3½	3¾	4
Diameter .. .. .. ,,	.636	.716	.795	.875	.954	1.03	1.11	1.19	1.27
Weight per yard .. .. lbs.	.48	.61	.75	.91	1.08	1.27	1.47	1.69	1.92
Working load .. .. .. cwts.	3½	4½	5¾	7	8¼	9¾	11¼	13	14½

ROUND HEMP ROPES—Continued.

Circumference .. .. .. inches	4¼	4½	4¾	5	5½	6	6½	7	8
Diameter .. .. .. ,,	1.35	1.43	1.50	1.59	1.75	1.90	2.05	2.20	2.52
Weight per yard .. .. lbs.	2.17	2.43	2.71	3.00	3.63	4.32	5.07	5.88	7.68
Working load .. .. cwts	16½	18½	20½	23	28	33	39	45	58

APPROXIMATE WEIGHT, STRENGTH, &C., OF BEST HEMP FLAT ROPE.

Size .. .. inches	5 × 1¼	5½ × 1⅜	5¾ × 1½	6 × 1½	7 × 1⅝	8½ × 2⅛	8½ × 2½
Weight per yard .. .. lbs.	12	13	14	15	18	20	23
Breaking strain .. .. tons	23	27	28	32	36	40	45
Working load .. .. cwts.	52	60	64	72	80	88	100

NOTES ON HAND POWER CRANES.—Attention has been directed elsewhere (page 3) to the limited duty obtainable from cranes and winches worked by manual power, and for that reason the necessity for excellence in design, proportions and workmanship.

One man working a handle, or lever, or pulling on a rope (British labour being the standard) can exert a force of 35lbs. for a limited time; but the maximum useful effort on a crane handle is about 25lbs. when raising a load through about 200 feet.

The useful limit of effort on a handle of 14 to 16 inches radius, (after ample allowance for friction) is 15 to 25lbs. when making 25 to 30 revolutions per minute.

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